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ABSTRACT

The purpose of this guide is to educate young people about the problems associated with solid waste. The activities encourage them to think about options for reducing the amount of waste they generate and how they can help by recycling and learning about other waste management alternatives. The lesson plans deal specifically with garbage and recycling, but in so doing encompass such broad areas as social and economic issues, natural resources and natural cycles, and a variety of pollution problems. Immediately following the Introduction are two short sections that are useful in carrying out the lesson plans. The first, Developing a Community Profile, will help students form a basis on which to make activities more relevant to their interests. The second, Clip Art for Source Reduction/Recycling Activities, will help teachers get started with some graphics ideas. The main body of the guide is divided into two sections: one for grades kindergarten through 6, and one for grades 7 through 12. The activities have been designed to give the teacher maximum flexibility. Each activity begins with an objective, and most introduce new vocabulary, which is defined in the glossary at the back of the guide. The first section contains 28 activities and the second 36 activities that are divided into units entitled: (1) "What is Waste?"; (2) "Where Does Waste Go?"; (3) "How Does Waste Affect Our Resources?"; (4) "How Can We Produce Less Waste?"; and (5) "What Can We Do About Waste?" Also, at the back of the guide are: a short skit about waste through the ages called "Throwaway Three," which can be performed by any grade level; addresses of state solid waste agencies; a list of information sources; and a material evaluation form. (KR)

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Let's Reduce and Recycle: Curriculum for Solid Waste Awareness

Lesson Plans for Grades K-6 and 7-12

U.S. Environmental Protection Agency 1980
Revised 1990

FOREWORD

The lesson plans in this curriculum guide are based upon those that emerged as part of a public education campaign to promote recycling awareness in Somerville, Massachusetts, in December 1975. The Somerville recycling program was funded by the U.S. Environmental Protection Agency (EPA) as a demonstration project to determine the feasibility of separating recyclable household waste from other waste prior to pickup. A major factor in the success of the Somerville program was the aggressive effort to inform residents of the program and of the importance of their participation. The school system was used to help spread information to children and, through them, to their parents. "Let's Recycle: Lesson Plans for Grades K-6 and 7-12" was first published by EPA in 1980.

In response to an increasing need for public awareness and participation in dealing with the solid waste "garbage crisis," EPA has revised "Let's Recycle." Sarah Carney of the U.S. EPA's Office of Solid Waste managed the project. The revision updates the activities and statistics on waste management and disposal, and reflects current attitudes toward recycling and reducing solid waste.

John Madama, Steppingstones, Inc. prepared the original curriculum package. Many of the ideas and activities were first developed by the Environmental Action Coalition of New York City in a series of teaching packets called "Don't Waste Waste." EPA acknowledges permission for their use and permission by the Atlanta Clean City Commission to reprint the skit "Throwaway Three."

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INTRODUCTION

In the United States today we too often discard items that in earlier times would have been repaired or saved for other uses. In fact, many modern products are designed for a relatively short life followed by a speedy trip to the refuse pile. As a nation, we currently produce about 180 million tons of municipal solid waste a year. This quantity of solid waste is enough to fill a convoy of garbage trucks stretching halfway to the moon!

How we can manage all of this waste in an environmentally sound manner is a complex and often controversial issue. Water pollution can result not only from dumping trash directly into the lakes, rivers, and seas, but also from runoff and leaching from dumps. Air pollution can result from faulty combustion and from decomposition gases surfacing in landfills. Fires, explosions, noxious odors, rodents, and disease also must be guarded against in landfills. And direct contact with refuse can be dangerous in some cases to the public as well as to the waste collectors and processors (who, incidentally, have among the highest on-the-job injury rates of any occupation in the nation).

Our disposal options are steadily being reduced. The so-called "open dump" is now an anachronism; it has been gradually phased out because of its potentially unsafe and unsightly conditions. Although more than 70 percent of our garbage is currently buried in landfills, more than one-third of the nation's landfills will be full within the next few years. Locating sites for new landfills (even facilities designed with state-of-the-art safeguards) is getting more difficult all the time due to economic constraints and public concern over human health and siting near neighborhoods.

Much of the opposition to landfills has been based on perceptions of possible pollution, health, and safety problems. In actuality, many of these problems can be avoided or controlled by proper siting, design, and operation of disposal facilities. New regulations for landfill design ensure that newly constructed landfills will remain safe for many years into the future. We are producing, however, an increasing amount of waste each year; by the year 2000, we are projected to generate 216 million tons per year. Waste disposal costs are also soaring. Longer hauling distances from metropolitan areas to landfill sites and more stringent environmental regulations push costs upwards, as do general increases in labor costs and rising land values. In some areas of the country, it can cost as much as $100 per ton or more to dispose of waste.

There is no single, simple solution to our communities' solid waste problem. To effectively reduce solid waste management problems, communities need to consider a hierarchy of *integrated waste management* techniques. The term "integrated waste management" refers to the complementary use of a variety of waste management practices to safely and effectively handle municipal solid waste with the least harmful impacts on health and the environment. The hierarchy consists of three levels: first, source reduction; second, recycling; and third, combustion and landfill.

At the top of the hierarchy is *source reduction*, or reducing both the amount and the toxicity of the waste we generate. Manufacturers may contribute to source reduction by designing and manufacturing products that contain fewer toxics and less packaging. As consumers, we can use our buying power to select more durable and nondisposable products, products that have more than one "life," and those with less packaging and fewer toxic components. One of the best ways to lessen our waste disposal problems is to reuse many of the things we have habitually thrown out.

Recycling, including composting of food and yard waste, is the next tier of the hierarchy. Widespread recycling efforts prevent potentially useful materials from being placed in landfills or combusted, thus preserving our limited capacity for disposal. Reuse of materials also saves energy and natural resources. It is good for American business and can help the economy. For example, aluminum cans, paper, and used oil (among many other items) can be reprocessed to make new products. The emphasis in "Let's Reduce and Recycle: Curriculum for Solid Waste Awareness" is on source reduction and recycling.

Waste combustion and *landfill* are next in the hierarchy of integrated waste management. Combustion reduces the bulk of municipal waste, while providing the added benefit of energy production. Source reduction and recycling can make combustion and landfill safer and more efficient by reducing the quantity and toxicity of the waste and removing recyclables that may be difficult to combust or may cause potentially harmful emissions.

Landfill will continue to be the major method of solid waste disposal for the near future. It is needed to handle waste that cannot be recycled or safely combusted. Also, residual ash from waste combustion must be disposed of in specially designed landfills. It is likely that there will always be some portion of waste requiring landfill no matter how efficient our reduction, recovery, treatment, and recycling processes become. We can, however, greatly reduce this portion by becoming aware of our own individual contributions to the solid waste problem and modifying our habits to promote wise use and reuse of our valuable resources.

It is no longer possible to hide the "garbage crisis" from the public eye. It threatens to weaken our cities and consume valuable portions of our natural resource base. The cost to communities of handling increasing quantities of solid waste diverts public funds from other important needs such as education and police and fire protection. The school system is an invaluable tool for increasing public awareness of this problem. Teachers are in an excellent position to enlighten our younger citizens about how solid waste problems relate to them, and how they can contribute to a solution.

HOW TO USE THESE LESSON PLANS

The purpose of this guide is to educate young people about the problems associated with solid waste. The activities encourage them to think about options for reducing the amount of waste they generate, and how they can help by recycling and learning about other waste management alternatives. These activities will also help young people to better understand the world around them: a world that faces many health and environmental problems caused by inadequate pollution control practices of the past. We hope that these activities will stimulate the students to reassess some of their present values and habits, and inspire them to make a postive impact upon the environment through action and understanding. The lesson plans deal specifically with garbage and recycling, but in so doing encompass such broad areas as social and economic issues, natural resources and natural cycles, and a variety of pollution problems.

Immediately following the Introduction are two short sections that will be useful in carrying out the lesson plans. The first, Developing a Community Profile, will help your students form a basis on which to make activities more relevant to their interests. The second, Clip Art for Source Reduction/Recycling Activities, will help get you started with some graphics ideas. The main body of the guide is divided into two sections: one for grades kindergarten through 6, and one for grades 7 through 12. The activities have been designed to give the teacher maximum flexibility — activities may easily be eliminated, modified, or rearranged, as class needs dictate. Each activity begins with an objective, and most introduce new vocabulary, which is defined in the Glossary at the back of the guide. Also, at the back of the guide are a short skit about waste through the ages called "Throwaway Three," which can be performed by any grade level; and two lists of additional information sources. Refer to the listing of State Solid Waste Agencies to learn more about resources available from your state. Use the Resources section to find out about books, posters, brochures, audiovisual materials, and other curriculum packages to supplement the activities in this guide. These materials also provide more in-depth information on many of the scientific and technical issues in the curriculum and thus would be useful additions to the classroom library for research projects and enrichment activities. In addition, many are free or are available at a minimal charge.

The teacher's most important role is to generate enthusiasm through student activities. Projects for all students should be encouraged, and the teacher's role as a lecturer minimized. Projects should be designed so that the student's personal involvement will carry over into a continuing consciousness for conservation in the home.

The Garbage Gremlin

The character who appears on the cover and in a number of graphics and activities throughout the guide is the Garbage Gremlin. EPA has chosen the "Gremlin" to represent the thoughtless wasteful habits that many of us unknowingly perpetuate. (Of course, the Garbage Gremlin takes great delight in his wasteful ways!) He can be seen in a variety of EPA publications on garbage-related issues. Students should be encouraged to identify the "Gremlin" where he appears and to discuss how his actions oppose the environmentally responsible attitudes they are trying to promote.

DEVELOPING A COMMUNITY PROFILE

You or your class may want to develop a Community Profile to help to relate the lessons in this guide directly to the situation in your community. Use the questions below to guide you in preparing your Profile. You can use the form on p. 6 to summarize this information. Many of these questions can be answered by contacting your Department of Public Works or Department of Sanitation. Do not worry if you cannot answer all of the questions right away — some will become clearer as you complete various activities.

1. **What is the population of your community?**

2. **How many tons of garbage does your community generate each day?**

3. **How many pounds are generated per person per day? Per year? (The national average is about 4 pounds per day, or over 1,460 pounds per year per person, but each community is different.)**

4. **How much are *tipping fees* (costs to dispose of waste at a landfill or waste combustion facility) in your community? (Landfill tipping fees in 1990 ranged among communities from $6 to over $100 per ton; combustion tipping fees ranged from $20 to over $60 per ton.)**

5. **What processes does your community use to manage solid waste? Is garbage burned for energy recovery, composted, or buried in a landfill? Is any of it recycled (separate collection of newspapers, cans, bottles, or used motor oil, etc.)? When will the local landfill be filled to capacity?**

6. **If there is a recycling program in your town, is it run by the city or county, business, or by private citizens? What products are made from the recycled materials? Also, are there any source reduction initiatives in your area, such as user fees for waste collection and handling, or education programs on source reduction?**

You might wish to help the students prepare an article describing the results of this survey for publication in the school or local newspaper.

COMMUNITY PROFILE

Name of Town: _____

Population: _____

Pounds of Garbage Generated Per Day: _____

Pounds of Garbage/Person/Day: _____

Pounds of Garbage/Person/Year: _____

Method(s) of Waste Management: _____

_____

Tipping Fees/Ton (land disposal, combustion): _____

_____

Cost to Community/Day: _____

Cost to Community/Year: _____

Recycling of Waste Materials:

- ☐ newspapers
- ☐ other paper/paper products
- ☐ plastic
- ☐ other wastes (please indicate)
  - _____
  - _____
  - _____
- ☐ aluminum cans
- ☐ other cans
- ☐ glass bottles
- ☐ used oil

Recycling Program: ☐ Yes ☐ No

Run by: ☐ City, County ☐ Citizen Groups ☐ Businesses

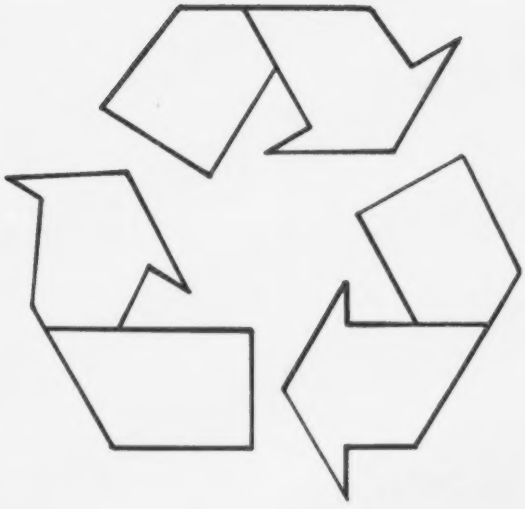
Clip Art for Source Reduction/Recycling Activities

The following pages contain Clip Art that can be photocopied for use in designing posters, brochures, classroom displays, or other materials to supplement some of the activities in the guide. These illustrations represent only a small portion of the graphic possibilities open to the creative student. Encourage students to expand on them and develop their own designs.

RECYCLE
CYCLE

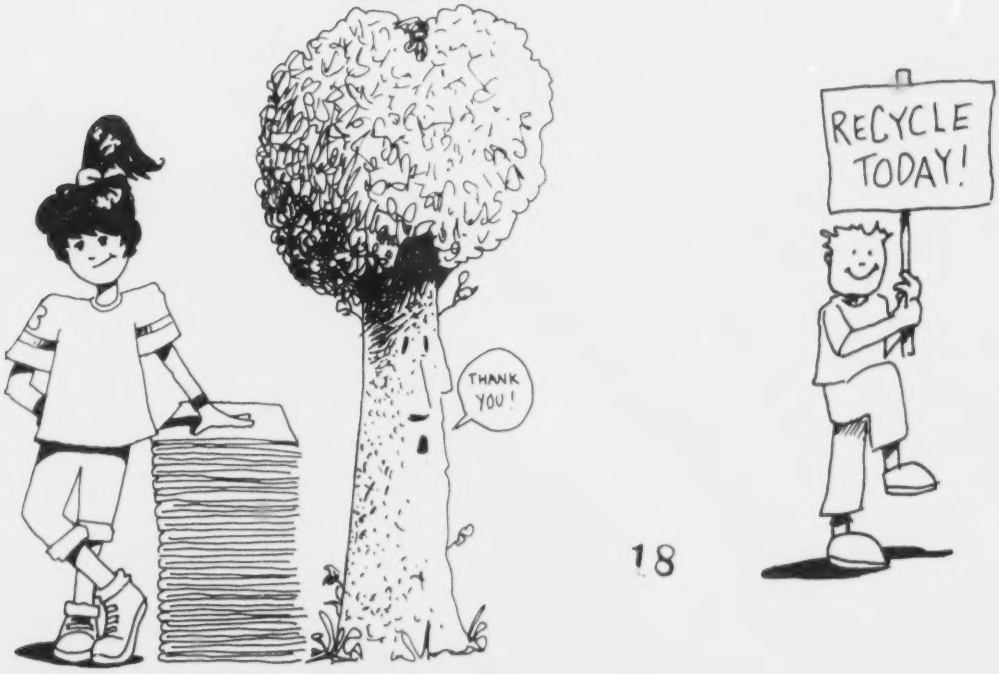
USED
MOTOROIL

RECYCLE
PAPER

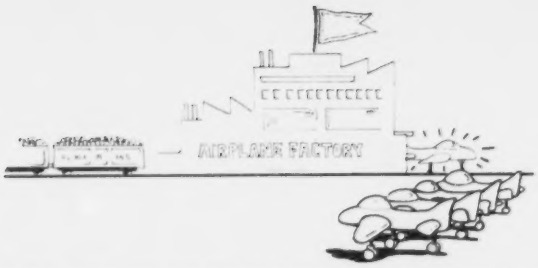


CANS
Bottles

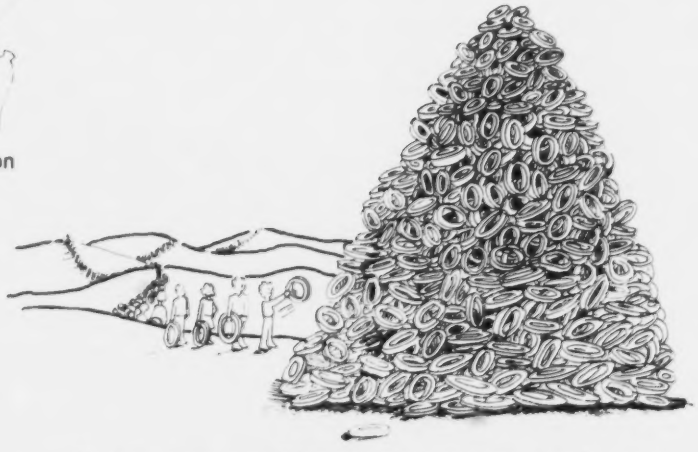
RECYCLE
CANS HERE
NEWS
PAPER
CANS
Bottles
1.
2.
3.
4.


THANK
YOU!
RECYCLE
TODAY!

We throw away 2.5 million plastic bottles every hour (22 billion plastic bottles a year).

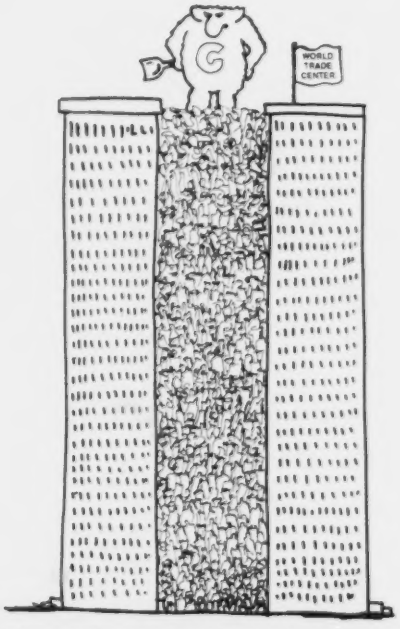


With the aluminum we throw away in 3 months, the United States could rebuild its entire commercial airfleet.

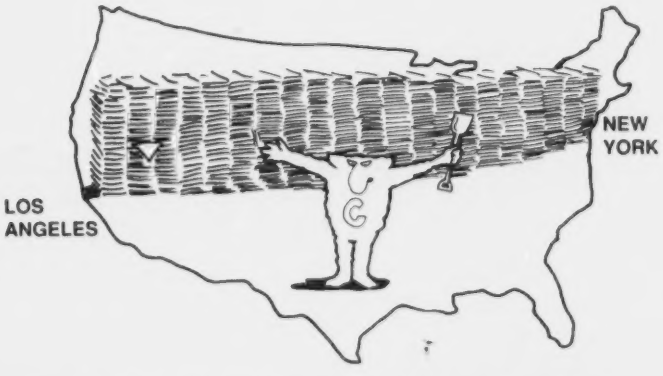


We throw away over 200 million tires every year (one for every person in the United States).

We throw away 31.6 million tons of yard waste each year.



Every 2 weeks, we throw away enough bottles and jars to fill the 1,350-foot twin towers of New York's World Trade Center.



With the office and writing paper we throw away every year, we could build a 12-foot high wall from Los Angeles to New York City.

GRADES K - 6

UNIT ONE

What Is Waste?

K - 6

Objective:
To define waste and discuss where it comes from.

Vocabulary: **waste** **garbage** **landfill** **combustor**

To lead into this activity, initiate a discussion based on the following questions:

Q Who knows what *waste* or *garbage* is?

Q What are some other names we have for waste?

Q Where do we put our classroom waste?

Have children cut out pictures from magazines of things that could be thrown out when they are used up or no longer needed and create a montage. You may want to have the entire class create one giant montage.

Then discuss with children where all of this trash might go:

Q What happens to our waste when it leaves the school?

Q What kinds of waste do we throw away at home? (Write them on the blackboard.)

Q Where does it go?

Q Has anyone ever seen a big *landfill* or *combustor*? (Explain that a landfill is a place where garbage is buried and a combustor is a place where garbage is burned. Activities 7 and 8 describe landfills and combustors in more detail.)

A followup activity might be to have the children draw their impressions of a landfill. The children could go on a field trip to a sanitary landfill or study magazine or newspaper photos, then draw or write their reactions.

Objective:
To introduce children to the Garbage Gremlin and what he stands for.

Photocopy the Clip Art illustration of the Garbage Gremlin riding beside the school bus and the older students' car, and distribute it to the class. Have children react to the picture.

Q What do you see in this picture?

Q What do you notice about the character at the bottom of the page?

Explain to children that this character is called the Garbage Gremlin. Ask children why they think he might be called that. Help them to understand that the Garbage Gremlin is a fictional character who is very wasteful and lazy. The Gremlin loves to litter and makes his home in garbage. Tell children that they will see him throughout these lessons and that they should pay close attention to whether his actions are helpful or harmful.

Have children color the picture. Then encourage them to draw their own Garbage Gremlins. You may want to use these pictures in a bulletin board display.

Objective:
To identify the many different types of waste.

Vocabulary: **metal plastic paper cardboard glass aluminum tin steel**

Have each child bring in one or two examples of waste from his or her home. (Ask children to be sure the waste has been cleaned as much as possible before bringing it in.) You may wish to bring in some examples, as well. The collection should include *plastic*, *paper*, *cardboard*, different types of cans, and *glass*. (It may be inappropriate for very young children to be collecting or handling glass.)

Label boxes or piles at the front of the classroom and have the children sort the waste into categories such as paper waste, *metal*, glass, and plastic. They should manipulate it as much as possible to feel the different textures and shapes.

Have the children determine which objects are attracted to a magnet. Explain to children that *aluminum* cans are not magnetic. *Tin* and *steel* cans will be attracted to a magnet.

Have the younger children trace outlines of the objects and make pictures of them to color. What are their shapes?

Older children might like to try making animals or useful objects out of the waste that has been collected. For example, children could decorate cans to use as pencil holders or make plastic containers or cartons into planters. At the conclusion of the activity, help children to understand that they have found one constructive way to use waste.

Notes:

UNIT TWO

Where Does Waste Go?

K - 6

Objective:
To illustrate the importance of clean air, water, and land.

Vocabulary: **air** **water** **soil**

For this activity, you will need a balloon, paper for folding fans, a glass of water, and a potted plant.

Ask a volunteer to blow up the balloon. Then let the air out slowly so that children can feel it with their hands. Explain to them that it is *air* that they feel.

Q Why do we need *air*?

Have children take a deep breath to understand that without clean air we could not live. Have them make a fan out of folded paper to see how air can be moved and felt. Discuss with them the wind, airplanes, whistles — these all illustrate air and its movements.

Show them the water.

Q Why do we need *water*?

Have children relate their experiences with water. Make a list on the board of all things they use water for.

Show them the potted plant.

Q What grows in the *soil*?

Q Does anyone have a garden?

Q If we had no soil could we have any food?

Discuss with children why soil is necessary for our survival.

Objective:
To introduce children to the concept of pollution and the different forms pollution may take.

Vocabulary: **pollution**

Q Who knows what *pollution* is?

Q How many have ever seen pollution? Where have you seen it? (land, air, water)

Q How does the waste we produce pollute the land, air, and water?

Q Why is pollution bad for us?

You might want to have children vote on which kind of pollution is the worst (land, air, or water). There is obviously no "right" answer, but make sure children can support their opinions with concrete examples.

Tell children that they will be performing some activities that demonstrate how pollution affects the land, air, and water.

Objective:
To help children identify litter in the world around them.

Vocabulary: **litter** **litterbug**

Have the children look for signs of pollution on the way to and from school. Tell them to focus on the garbage they see strewn along the ground. Alternatively, you could take younger children on a "litter hunt" and have them record the number of different types of litter they see.

Q What is the most common type of *litter*?

Q Where is the most litter found?

Q What is a *litterbug*?

Q Do you think the Garbage Gremlin is a litterbug? Why?

Organize a litter cleanup of your school or neighborhood, or a local recreational area. As children collect the litter, have them sort it into proper categories (paper, plastic, aluminum, tin cans, etc.). A variation would be to conduct a "litter rap" around the school grounds or a block adjacent to school property. With a rap beat playing on a portable tape player in the background, have children spot pieces of litter, then make up short "raps" one at a time to describe them. For example:

Can on the street is not too neat,
Ugly litter I kick with my feet.

I see a bottle beside that fence.
Let's bring it in and earn five cents!

That paper's from a burger and fries —
Wish someone hid it away from my eyes.

You might wish to record the song as children make it up a verse at a time, or have children write down their own "raps." Then compile them into a song to perform for the grade or school.

Objective:
To allow children to compare what happens to waste in a dump and in a landfill.

Vocabulary: **open dump** **sanitary landfill**
contaminate **leachate**

In partners, have children construct both a mini-landfill and a mini-dump and compare the two over the course of several weeks. Or you may wish to have each child construct a mini-landfill, but make just one mini-dump for the whole class.

To make the landfill, have children cut three quarters of the way around the top of a 1-gallon plastic milk or water jug. Have them place a layer of soil on the bottom, then alternate layers of soil and garbage, leaving a layer of soil at the top. The garbage should include a variety of organic and inorganic items: a metal barrette or paper clip, a piece of plastic, a piece of aluminum foil, a piece of newspaper, a candy or gum wrapper, a piece of food (apple, orange skin). Sprinkle with water, seal the openings with masking tape, and cover with the lid. Open the lid to air and water the landfill approximately every other day.

For the dump, fill a second plastic jug with soil and place the garbage on top. Sprinkle the dump periodically with water, and leave it uncovered.

Have children list all of the items they have placed into their dumps and landfills and keep separate charts monitoring the changes in both. At the end of the observation period, discuss with children the differences between what happened in the dump and in the landfill.

In the dump, over a period of time you can expect the food to rot and smell slightly. The newspaper will also begin to break down. (You may wish to explain the process of decomposition to children. Refer to Activities 21 and 22.) Paper wrappers will decompose as well, but plastic will not. The metal barrette will gradually rust and nothing will happen to the plastic or aluminum foil. Very little decomposition should take place in the landfill and it should not smell.

Q Can you think of any problems that might result from disposing of garbage in an *open dump*? (Answers might include odors; attract rats or other pests; disease; ugly; trash could spread to other areas and pollute them; run out of space to put more garbage.)

Point out to children that, in the past, dumps did not protect the surrounding environment from the trash dumped into them. Landfills present better ways of disposing of our garbage. Modern *sanitary landfills* prevent waste from polluting or *contaminating* the land around them. Deposited waste is covered daily with soil for added protection. Modern landfills also

control any liquid, or *leachate*, that accumulates in the buried waste so that it does not leak into the environment. (A diagram showing one modern sanitary landfill design appears on p. 63 of this guide. You may wish to distribute copies of this diagram to older children during the discussion.)

Children should be aware that many of the environmental problems associated with dumps have been eliminated with sanitary landfills, which will continue to be the major form of disposal for many years to come. They should also realize that little decomposition occurs in this type of landfill.

Objective:
To learn about the harmful effects of burning and the alternative of waste combustion.

Vocabulary: **burning ash combustor waste-to-energy plants**

Some problems with open *burning* of waste may be examined by using a tin can with air holes punched around the bottom. Loosely place in it small pieces of waste food (such as apple core, egg shell, small piece of carrot), aluminum foil, plastic wrap, glass, and newspaper. In a safe place outdoors, light a match to the contents. Have the children observe what happens.

Q Which items burn and which don't?

Q Which things melt?

The paper will burn easily. The food will char, but not really burn. The plastic will catch on fire and drip down into the pan, giving off fumes as a result of its petroleum base, and leaving a sticky residue. The metals will not burn at all.

Q When we burn our garbage, where does the smoke go? Is this air pollution?

Q What can happen to us when too much smoke gets into the air?

Q What happens to the *ash* produced?

Q Could the heat given off be used? For what?

Explain that waste can be burned safely and that harmful effects on the environment can be greatly reduced by using properly constructed and operated waste *combustors*. These combustors must have special controls to avoid polluting the air. Tell children that after the waste has been burned, there is still ash left over. This ash should be disposed of in a specially constructed sanitary landfill.

Modern combustors also create energy through the heat given off when waste is burned. This energy can be used to heat homes or provide electricity. Waste combustors that also produce energy are known as *waste-to-energy plants*. (A diagram of a waste-to-energy plant is shown on p. 60 of this guide.)

Tell children that land disposal and combustion are two ways that communities can manage their waste. Source reduction — or reducing waste before it is produced — and recycling are two other methods which will be discussed in later activities. (**Source reduction**, Activity 16; **Recycling**, Activity 23).

Objective:
To demonstrate how garbage can pollute the water.

Vocabulary: runoff

Explain that garbage can also pollute water. Illustrate by having the children place different types of garbage such as shredded paper, food scraps, a tin can, and a dark liquid such as coffee into a clear bowl containing clean water. Let the children observe the changes in the water after each addition.

Tell children that water becomes polluted by garbage even when the garbage is not put directly into the water. Illustrate by pouring some ink onto a mound of sand that has been placed in a bowl. Explain that the ink represents the pollutants in garbage. Sprinkle water over the mound (to represent rain) until it drains into the bowl.

Explain that in the environment this water would run off into rivers and lakes or would seep down into the ground and pollute the water there. Ask if anyone has a well. Help children to understand that there is water in the ground that we use for drinking and bathing, and that this water can become polluted by *runoff* from garbage that is not properly managed.

UNIT THREE
How Does Waste Affect Our Resources?

K - 6

ACTIVITY 10

Objective:
To introduce the concept of natural resources.

Vocabulary: **earth** **natural resources** **energy**

Have the children name objects made of paper, metal, and glass, and a favorite type of food.

Using the blackboard or a large piece of paper, help the children trace these materials back to their source. For example, a soda bottle is made from sand mixed with soda ash and lime and melted down to form a liquid, which is then molded into glass. See if the children can trace the origin of the other objects illustrated below. (Refer to the "Resource Tree" on p. 69 to trace the origins of additional everyday objects.)

SODA BOTTLE

GLASS
SAND
ROCKS

CEREAL BOX

PAPER
WOOD
TREES
SOIL

METAL CAN

ROCKS
TIN/STEEL/ALUMINUM

APPLE

TREES
SOIL

EARTH

Ask the children if they can think of anything that they use that is not provided by the *earth.* (The children will probably name some things, but on close examination, it will be seen that these things also come from the earth.) Explain to children that raw materials that we take from the earth to make into other things are known as *natural resources.* Help children to list the natural resources used in the objects named on the previous page. Remind them that *energy,* which is also a natural resource, is needed to change objects from their natural forms into the products we use.

Q What are some forms of energy? (solar, wind, thermal, electrical, nuclear, mechanical)

Q What kind of energy does a tree need to produce fruit? (solar)

Q What kind of energy does a windmill use? (wind)

Objective:
To illustrate the use of a natural resource.

Vocabulary: **reuse** **fuels**

Pass out clay from a container labeled "earth," explaining that this is an example of one of the earth's resources. Let the children make models of things that they like to use.

Write the words BURY, BURN, and THROW AWAY on three small boxes or cups. Let the children place their clay product into one of the three boxes.

Q After we bury, burn, or throw away these objects, what will happen to them?

Repeat several times to show that as we buy and use products, we use up the supply of the earth's materials. When there is no more clay, point out that the resource container is now empty and that the resources have been used up. Point out how heavy the boxes are, and that someone will have to take them to the disposal site, where they will take up room and may contribute to pollution. Also, point out that the clay is still valuable material that can be used.

Q Can we ever get back the things we throw away? Which ones?

Q What is going to happen if we keep taking materials from the earth? What will happen when we run out?

Suggest that instead of burying, burning, or throwing the clay away children could *reuse* it. Explain that if we did this with all our garbage, very little would have to be buried in a landfill or burned, and we would not take as much from the earth. Point out that even the burning of waste can generate heat, which can be used in creating energy, thereby saving precious *fuels*, such as oil and coal.

Objective:
To illustrate that by wasting things in our home and at play we are using up the vital resource supply of the earth.

Vocabulary: waxed cardboard

Ask each child to list all the different containers that provide his or her evening meal; include all the materials used to make the container. For example, a child who eats soup, hamburger, ketchup, apple sauce, carrots, ice cream, and milk might have a list resembling the following:

Soup — metal can with label

Hamburger — plastic tray and clear plastic wrap

Ketchup — glass bottle, metal cap, paper label

Apple sauce — glass jar with metal top and paper label

Carrots — plastic or paper bag

Ice cream — paper or cardboard container

Milk — waxed cardboard container

Ask each child to count the number of containers that use each different material (glass, metal, paper, etc.) and the total number of containers used in his or her household. Children will be interested in seeing which family threw away the most items. Stress accuracy — there will be a tendency to give elaborate totals and to magnify the amount used.

Ask each child to divide the total number of containers used by his or her household by the number of people in the household. This number will be an estimate of the amount thrown away at one meal by one individual. Then have children multiply this number by three to get an estimate for 1 day. To continue this illustration, estimate the number of containers thrown away in 1 day by the whole class. This total will be amazing to them.

Have the children imagine that all the containers the class threw away yesterday were stacked up in a corner of the room.

Q How much of the room would it occupy?

Q How much of the room would a week's worth of garbage occupy?

Use the figure representing the number of containers thrown away by one person in 1 day. Multiply by the number of people in the community to determine the total number of containers thrown away in your community for 1 day. Multiply that number by 365 days a year. Review that these containers are made of resources that are necessary for survival.

Objective:
To give children an appreciation of waste disposal costs.

Vocabulary: pound ton cost tipping fees

Bring in a scale and a bag of clean garbage containing an assortment of glass and plastic bottles, cans, cartons, and paper waste. (Or use some of the garbage brought in for Activity 3 if you were able to store it.) Call on a volunteer to weigh the bag of garbage and then weigh him or herself. Write the two numbers on the board.

Tell children that the average person in the United States throws away 4 *pounds* of garbage each day. Based on this statistic, ask children to answer the following questions:

Q How many days' worth of garbage was contained in the bag we just weighed?

Q How many days would it take you to throw away an amount of garbage equal to your own weight?

If each person in your community (pop._____) throws away 4 pounds of garbage each day:

Q How many pounds does this equal in 1 day?

Q How many *tons* is this?

To help children grasp the concept of a ton (2,000 pounds), you might want to ask them how many tons some familiar objects weigh (an average 4-door compact automobile weighs about 1 ton).

Have the children try to imagine where all this refuse is being put every day of every year in every community.

You can also go further and get population statistics for your state and the entire United States, and multiply these numbers by 4 pounds. Remind children that much of this garbage is made up of resources that could be put to good use.

Tell children that it *costs* money to dispose of all of this waste. Have children imagine that it costs your community about $30 for each ton of refuse that is disposed of in a landfill or burned in a waste combustor (or use the amounts for *tipping fees* from your Community Profile):

Q How much would waste disposal or combustion cost your community each day?

Q How much would it cost per year?

Q Where does this money come from?

To give children a better appreciation of this sum of money, ask them the price of a cassette tape or compact disk of a popular group. (For younger children, you might ask how much they get for an allowance or how much it costs to buy lunch at school.)

Q Approximately how many cassettes or CDs could you buy with the money your community spends on landfill or combustion in 1 day? In 1 year?

You might want to have children calculate how much money could be saved if each person in the community reduced the amount he or she threw away each day by 1 pound.

Objective:
To help children realize the enormous amount of resources Americans throw away.

vocabulary: **population** **statistic**

Draw a square on the floor with chalk, approximately 5 feet by 5 feet. This square can also be delineated by grouping chairs to form the perimeters. Ask one child to step inside the square holding one piece of solid waste, probably scrap paper. Emphasize that each person involved cannot step outside the square once he or she is in it.

Then ask another to step in, representing a couple. Assume they then have two children, those two marry and have two children, etc. The number of children in the square will go up very quickly, yet the square remains constant. Ask the children how they would be able to get anyone *out* of the square. As the square grows more crowded, obvious reactions will be observed, especially pushing, restlessness, and generally aggressive behavior.

Ask all the children to drop their pieces of solid waste into the square and return to their seats. The result will certainly be solid waste pollution. This vividly illustrates the concepts that an increasing *population* creates more waste, that our crowded cities have limited space, and that the amount of waste pollution increases every year.

Share with children the following *statistics*.

Every 2 weeks, we throw away enough bottles and jars to fill the 1,350-foot twin towers of New York's World Trade Center.

We throw away 31.6 million tons of yard waste each year.

With the aluminum we throw away in 3 months, the United States could rebuild its entire commercial airfleet.

We throw away 2.5 million plastic bottles every hour (22 billion plastic bottles a year).

With the office and writing paper we throw away every year, we could build a 12-foot high wall from Los Angeles to New York City.

We throw away over 200 million tires every year (one for every person in the United States).

Children may want to try illustrating some of these enormous quantities or creating posters for the classroom based on these figures. (See the Clip Art pages for some illustration ideas.)

UNIT FOUR
How Can We Produce Less Waste?

K - 6

Objective:
To explore changes in lifestyle that have led to increased production of waste.

Vocabulary: **disposable** **product** **durable**

Q What do you do when your pen runs out of ink?

Most children will say that they throw it away or get a new one. Explain that an item that is made to be used once or for a short period of time and then thrown away is called *disposable.*

Q What are some examples of disposable *products* that you have used? (diapers, pens, razors, cameras, shopping bags, wrapping paper, fast food containers, plastic eating utensils, paper plates, paper napkins, paper towels)

Q Why do you think people use these disposable products rather than more *durable*, or long-lasting, alternatives?

Help children to understand that people often use disposable items because it is easier, and sometimes cheaper, to replace these items than to clean, refill, or repair nondisposable products. However, although it may be more convenient to throw out paper plates, paper cups, and plastic utensils than to wash dishes, these disposables create a tremendous amount of waste.

Q Do you think people have always thrown away as many things as they do now? Why or why not?

Discuss with children what kinds of changes in lifestyle have caused us to create more waste in our day-to-day lives. Some examples might include:

Buying new clothing instead of mending socks and patching worn clothing.

Eating prepared foods or "fast foods" rather than cooking food from scratch.

Buying individual servings or amounts convenient for storage instead of buying foods in bulk quantities.

Getting plastic or paper bags with each purchase instead of shopping with baskets or reusable bags brought from home.

Replacing broken items rather than repairing them.

This would be a good opportunity to read the skit "Throwaway Three" at the back of the guide, focusing on the issue of waste production through the ages. You might also conduct this activity in conjunction with a social studies unit on how people lived at a certain period of time in history. Compare their use of resources and generation of garbage with our own. Have children work in groups to prepare skits showing the contrast between the two societies.

Objective:
To introduce children to the concept of source reduction.

Vocabulary: **source reduction**

Review with children some of the problems associated with having too much garbage:

Air, land, and water pollution.

No place to put all of the waste.

Shortages of natural resources.

High costs of burying or burning garbage.

Have children imagine that for 1 week they are not allowed to throw anything out in a garbage can at home or at school.

Q How would you eat?
(Bake your own quick breads and cookies, drink juice in the largest containers you could find, buy vegetables without any wrapping, buy huge boxes of cereal.)

Q How would you clean up a spill?
(Use reusable rags and sponges instead of paper towels.)

Q What would you do if you tore your clothes?
(Patch them or sew up the hole.)

Q Can you think of any other habits you would have to change for that week?

Explain to the class that eventually they would probably have to start throwing out some things — the empty juice container, the cereal box, the wrapper from a new bar of soap. However, putting into practice some of the ideas they just mentioned could drastically reduce the amount of garbage they produce.

Tell children that what they have just been talking about are methods of *source reduction.* Explain that source reduction is the concept of using up fewer materials so that less waste is produced. Define for children or call on volunteers to define the words *source* and *reduce* to give children a better understanding of the term. There are several components of source reduction:

1. **Cutting down on the quantity and weight of waste, including cutting down on packaging of the products you use.**

2. **Making things last as long as possible, thereby extending the useful life of products.**

3. **Using things more than once for the same or for different purposes, such as taking a clean jug back to a farmstand to be refilled with cider or using a specially designed jelly glass as a drinking glass.**

4. **Using products that are less toxic, meaning those that contain potentially harmful ingredients.**

These components will be discussed in more detail in the next few activities. Help children to understand that the less waste we produce, the fewer problems we will have disposing of it.

Objective:
To help make children conscious of packaging and ways that it can be reduced.

Vocabulary: **ecological packaging** **green product** **toxicity**

Construct a visual aid in the form of a bulletin board or display using packages and pictures of packaging brought from home by teachers and children. Actual packages work best, but carefully chosen pictures are also valuable. The bulletin board display can evolve into a comparison of "good" and "bad" packaging. The board can be broken down into three categories:

1. **Nature's packaging: coconut, bananas, peanuts, etc.**
2. **Older types of packaging: paper bags, pottery, returnable bottles.**
3. **Modern packaging: plastic wrap, plastic foam, plastic-coated milk and juice containers, and individually wrapped packets.**

Q What are these packages made of?

Q What natural resources were used to make them?

Q Which packages can be reused?

Ask children to consider what materials might need elaborate packaging and why (for example, aspirin capsules need to be sealed for health reasons). Point out the ways in which packaging can prevent waste by reducing spoilage and providing individual servings. Ask if some packages use excessive materials, and thus contribute to the waste problem (for example, packages of gum in which each piece is individually wrapped in two wrappers).

Q How would you design an *ecological package* (one that requires as little energy and as few resources as possible for its production or disposal)?

Tell children that another name for a product that uses ecological packaging and does not harm the environment is a *green product*. You might ask children to take a trip to the supermarket or drugstore and look for the most ecological and the most wasteful packaging.

Remind children that cutting down on product packaging and reusing packaging materials are important aspects of source reduction. Tell children that they can encourage their households to buy products with less packaging and to bring containers from home when they shop. You might have them prepare a list of source reduction "shopping tips," individually or as a class.

Objective:
To show children that some things that are thrown out have value.

Vocabulary: valuable

Q What might there be in one person's trash that would not be trash or waste to someone else?

Set up a "swap box" where the children can bring in old toys or objects that might be thrown out. They can trade an old toy for another one that is new to them. An alternative would be to set up a collection box for a local Goodwill or Salvation Army collection.

As a homework assignment, ask the children to write a short story, real or imaginary, describing something *valuable* that they found buried in the garbage. The stories should include accounts of the previous owners and reasons why the objects were thrown away.

Explain to children that one way to make something last longer — or extend its "life" — is to share it with someone else once you have outgrown or grown tired of it.

Objective:
To introduce children to the concept of reuse as an alternative to disposal.

Vocabulary: reuse

Ask children how many uses they can think of for a large peanut butter jar or a coffee can. Write them on the board. Tell children that many things can be used again, or reused in the same or in different ways.

Set up a "use-it-again" box for your classroom. Have the children paint, color, or paste pictures on it. Suggest that children place in it all materials that can be used again. Encourage children to contribute to the "use-it-again" box on a day-to-day basis. For example, paper that has only been used on one side can be used again for drawing paper, quiz sheets, etc. Craft items from home (egg cartons, margarine tubs, thread spools, etc.) can also be brought in to make collages and other art projects.

Objective:
To understand product toxicity and explore ways to reduce it.

Vocabulary: toxic nontoxic

You might want to introduce this activity by asking children to have their parents help them find five things around the house that could be harmful to the earth. Stress that children should not handle these items. Begin a discussion by talking about what children have found.

Q Have you ever seen a product with a label that says "warning," "danger," or "caution"? What does this mean? What kinds of products have these labels? (ammonia, turpentine, bug spray, drain cleaner, nail polish remover)

Q What does the label usually warn you against doing? (swallowing, getting it in your eyes, maybe getting it on your skin) Why?

Explain to children that substances that contain ingredients that may be poisonous are called *toxic*. Encourage children to consider where waste from toxic products might end up and why it might cause problems to people or to the environment. Explain to them that many of these toxic substances can be replaced by *nontoxic* or less toxic products that do the same job.

Ask children if any of them have seen boxes of baking soda in refrigerators or sachets of herbs in closets or drawers. Explain that these are nontoxic substitutes for air fresheners that may contain toxic ingredients.

Let children know that some products, such as household batteries, also contain ingredients that become harmful only after they are thrown out and may leak into the environment. (See Activity 7.)

You may want to conduct the following demonstration of a nontoxic substitute for the class. Tell children you are going to show them a homemade "silver polish" that is safe and can be made from ingredients they have around the house. Boil 2 to 3 inches of water in a shallow pan with 1 teaspoon of salt, 1 teaspoon baking soda, and a sheet of aluminum foil. Totally submerge a piece of silverware and boil for 2 to 3 minutes. Wipe the utensil with a cloth; tarnish should come off. Repeat the procedure if any tarnish remains.

Notes:

UNIT FIVE
What Can We Do About Waste?

K - 6

ACTIVITY 21

Objective:
To show children the function of mold in nature.

Vocabulary: **mold** **decomposition**

Ask children if they have ever noticed anything growing on food when it is old. As a demonstration, place very small pieces of fruit such as apple, orange skin, and bread on top of some moist soil in a container. Cover with clear plastic and a rubberband. Observe the changes over a few days.

Ask the children if they know what is growing on the food. Explain to them that these are *molds* and that they feed on this food, converting it to nutrients and organic matter in the process. The nutrients and organic matter then become available for reuse by plants. Tell children that this process, known as *decomposition*, is one way nature reuses its resources.

ACTIVITY 22

Objective:
To introduce children to the concept of natural cycles.

Vocabulary: **organism** **natural cycle** **compost**

Collect dead leaves in several stages of breakdown or take a field trip to a wooded area to show children what happens to leaves after they fall.

Q Do you know what becomes of all the leaves that are on the ground in the fall?

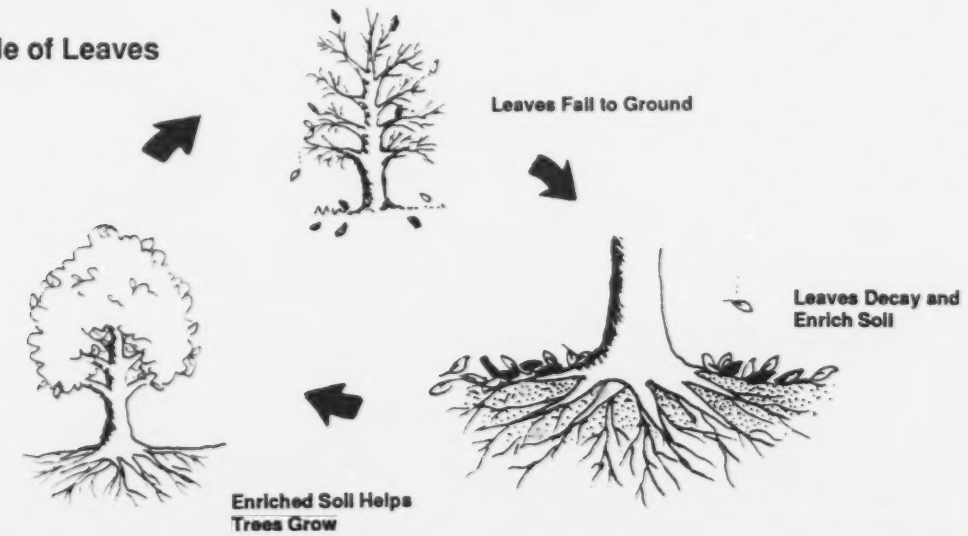
Q Where do they go next summer?

Make the connection that leaves become soil by letting the children see and feel the layers of leaf and soil that you collected. Have children make sketches and take notes on what they observe. Explain to children that, along with molds, other tiny *organisms* break leaves down into soil.

Help children to understand that a tree's leaves fall, decay into the soil, nourish the tree by making the soil richer, and thus help the tree to grow and produce more leaves. Tell them that a series of events in nature that repeat over and over is called a *natural cycle*.

Using their sketches, have children make a large art mural showing all the stages in the cycle of leaves. (You may wish to refer to the illustration below.)

Cycle of Leaves



Another way to illustrate the leaf cycle for younger children would be to print the following words on 3 x 5 cards: *soil, roots, trunk, branch, buds, green leaves, dead leaves.* Distribute the seven cards to seven children at random. After each child has shown his or her card to the class, give a long piece of string to the child holding the card marked "soil." Ask the children to arrange themselves in order according to stages of growth and decay. As each determines his or her corresponding position, he or she should take hold of the string. They should end up in a circle.

Explain to children that some households and communities put their food and yard waste in outdoor piles called *compost* piles. These materials will also decompose into the soil, and can then be used as compost to enrich soil for gardening or other planting. Recall for children the statistic in Activity 14: *We throw away 31.6 million tons of yard waste a year.* (Also, see Clip Art, p. 12.) Composting helps reduce the amount of waste that must be landfilled or combusted. Tell children that composting is a form of *recycling*, which they will learn more about in the next activity.

Objective:
To introduce the concept of recycling as an alternative to disposal.

Vocabulary: recycle

Write the word *recycle* on the board or a large sheet of paper. Next to it draw a picture of a bicycle wheel. Point out to the children that both end in the word *cycle*.

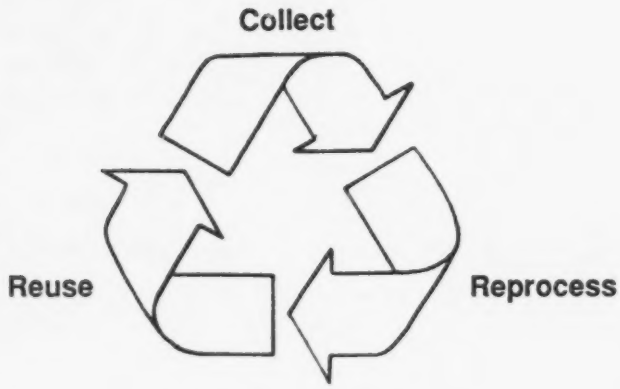
A bicycle wheel goes around and around — the word *recycle* means to use over and over again, or to go around. Show children the recycling symbol on the following page and explain to them that the three arrows represent the three stages involved in recycling materials: collect, remake, and reuse. You might wish to have children practice drawing the symbol.

Point out that when we recycle a product, it does not add to our garbage but goes back around into something new. As the leaves go back into the soil to help a new tree grow, manmade materials can also be broken down and used to make new materials. Old paper can become new paper; old cans and glass become new cans and glass, etc.

Have each child list the possible advantages of recycling. Call on volunteers to read from their lists, and write the major advantages on the board:

1. **Reduces pollution**
2. **Saves natural resources**
3. **Saves energy**
4. **Saves money**
5. **Saves landfill space**

As a result of this activity, the children should become very familiar with the word *recycle* and use it frequently.



Objective:
To review the ideas of recycling and reuse.

Have a show-and-tell session where the children bring in objects and discuss how they could be either reused or recycled. Children can put all objects that can be used again in the classroom into the "use-it-again" box that they set up in Activity 19.

Objective:
To increase children's awareness of recycling in their community and get them involved in school recycling efforts.

Vocabulary: **recyclable**

If there is a recycling center in your community where you can bring paper, cans, bottles, plastic, or other *recyclables*, set up recycling boxes for the classroom. You should have a separate clearly labeled box for each type of recyclable collected (aluminum, white paper, newspaper, plastic soda bottles, glass bottles, etc.). Stress to children the importance of separating their waste for recycling. Use the exercise on pp. 44-45 to test children's knowledge of recyclables and waste separation.

When you take the materials to the center, bring the class to see how it is run. Find out if your class could bring in recyclables from a 1-day community collection or an ongoing recycling program at the school.

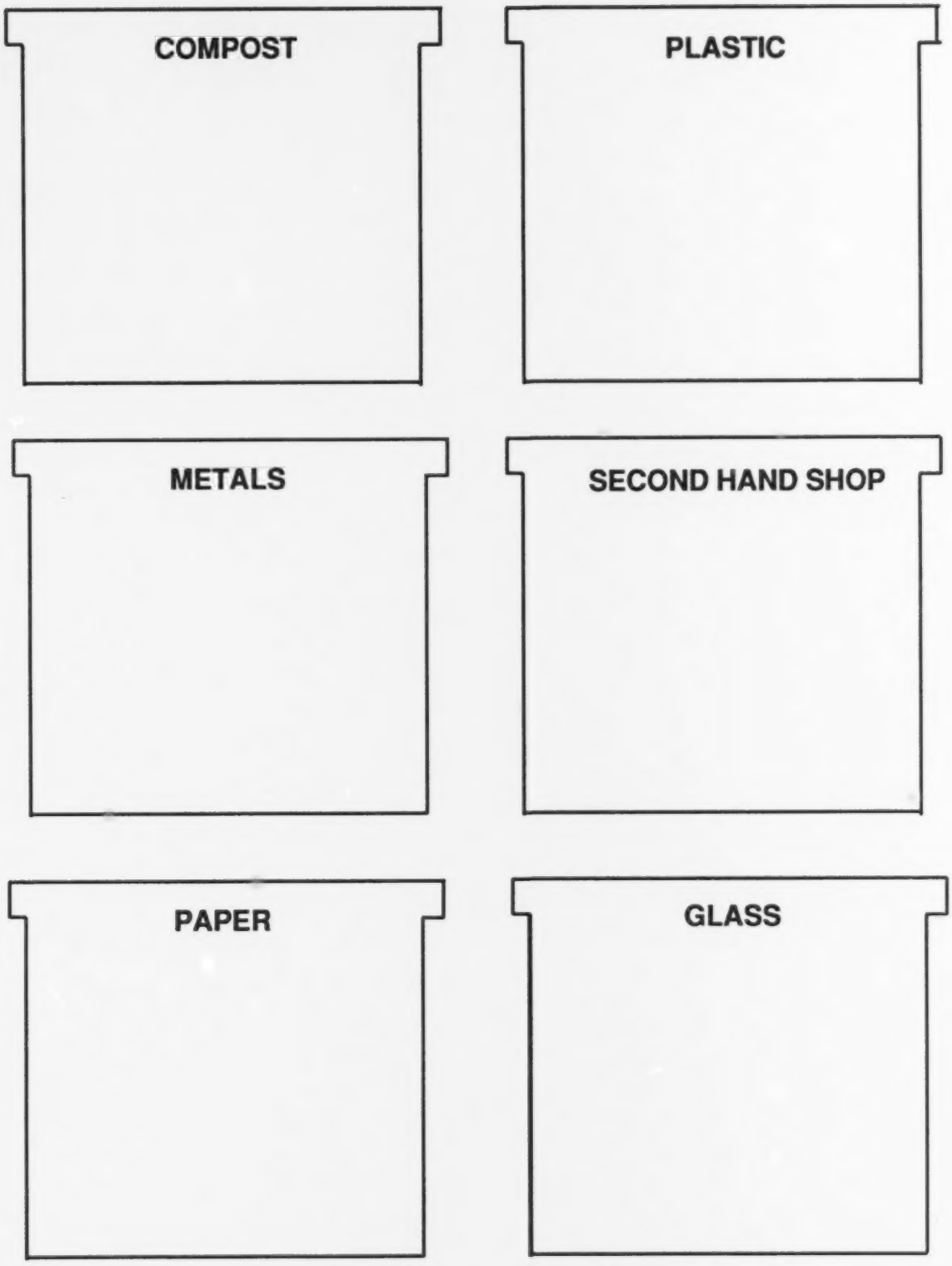
If there are no recycling centers in your area, research with children possible markets for your waste materials. Look in the Yellow Pages of the telephone book under *recycling programs*, *waste paper*, or *scrap dealers*, and consult the list of State Solid Waste Agencies at the back of this guide.

Have children start a school recycling program. They could begin by setting up collection boxes for used writing paper in all of the classrooms. A collection drive for certain recyclables, such as aluminum, could be used as a fundraiser for a class trip. You might organize a competition between grades for the most recyclables collected, and offer a prize of a movie or a trip to the winning grade. The U.S. EPA has published a brochure, "School Recycling Programs: A Handbook for Educators," which should be very helpful. (See list of Resources at the back of this guide.) Use Clip Art pages at the beginning of the guide to design posters or brochures to promote the program.

Note: Be sure you have suitable markets for your recyclables before you begin a collection program! Find out exactly what kinds of material each market will accept. For example, must paper be high grade paper?

Save! Sort! Recycle!

Color the recyclables in the boxes on this page. Then cut them out and paste them into the proper recycling bins on the other page.


COMPOST
PLASTIC
METALS
SECOND HAND SHOP
PAPER
GLASS

Objective:
To illustrate how a common manufacturing process uses resources.

Take a field trip to a papermill or glass manufacturer that uses recycled paper or glass, or to another type of facility that uses recyclables in its manufacturing processes. Discuss with children how many resources the manufacturing process uses (for example, trees, water, energy for papermaking) and how these resources could be saved by using recyclables. Arrange to have someone from the facility speak to the class about its use of recyclables. Find out where the papermill or manufacturer gets the materials that it uses in its processes.

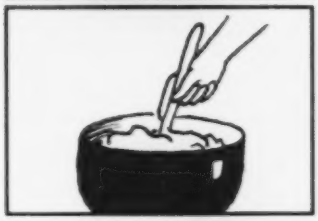
This activity could be followed by making recycled paper out of old waste paper in the classroom.

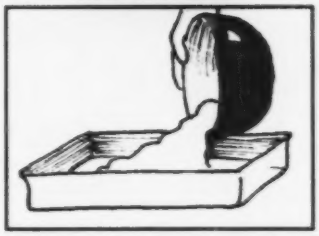
MAKE YOUR OWN PAPER

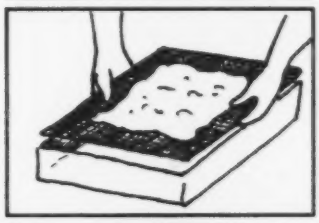
What You Need

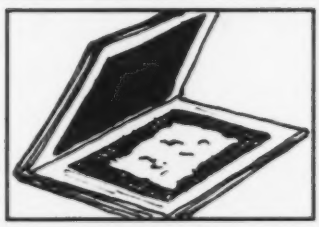
Old paper (anything but newspaper)
A piece of screen
A flat dish, a little larger than the screen
4 pieces of blotting paper the size of the screen
A bowl
An egg beater (a blender would be better)
A round jar or rolling pin
Newspaper and blotter paper
2 cups of hot water
2 teaspoons of instant starch (for stronger paper, if desired)

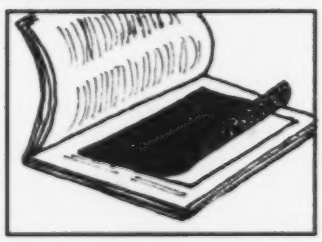
What to Do











1 Tear the paper into very small bits into the bowl. Pour in the hot water.

2 Beat the tissue and water to make pulp.

3 Mix in the starch if desired.

4 Pour the mixture into the flat dish.

5 Slide the screen into the bottom of the dish and move it around until it is evenly covered with pulp.

6 Lift the screen out carefully. Hold it level and let it drain for a minute.

7 Put the screen, pulp side up, on a blotter on some newspaper. Put another blotter over the pulp, more newspaper over that.

8 Roll the jar over the sandwich to squeeze out the rest of the water.

9 Take off the top newspaper. Turn the blotter sandwich over so that the screen is on top. Then take off the blotter and the screen very carefully. Don't move the pulp. There is your paper.

10 Put a dry blotter on the pulp and let it dry.

11 Use the paper for an art or writing lesson. How is this paper different from normal drawing or writing paper?

Objective:
To encourage children to extend their new awareness of source reduction and recycling outside of the classroom.

Discuss with children what they can do to reduce waste and recycle at home:

Use all of your paper on both sides.

Use grocery bags to hold garbage instead of buying garbage bags.

Use grocery bags to wrap packages to send through the mail.

Use grocery bags for art projects.

Buy food in bulk quantities.

Pack your lunch in reusable containers.

Use silverware and dishes instead of disposable plastic utensils and plates.

Reuse plastic and glass containers to store food.

Use returnable glass and plastic bottles.

Compost yard wastes.

Save paper, glass, aluminum, and other recyclables and bring them to a recycling center.

Participate in a local recycling program.

Get involved in starting a school recycling program.

Give things that you no longer use to people who can use them.

Borrow things that you don't use very often, instead of buying them.

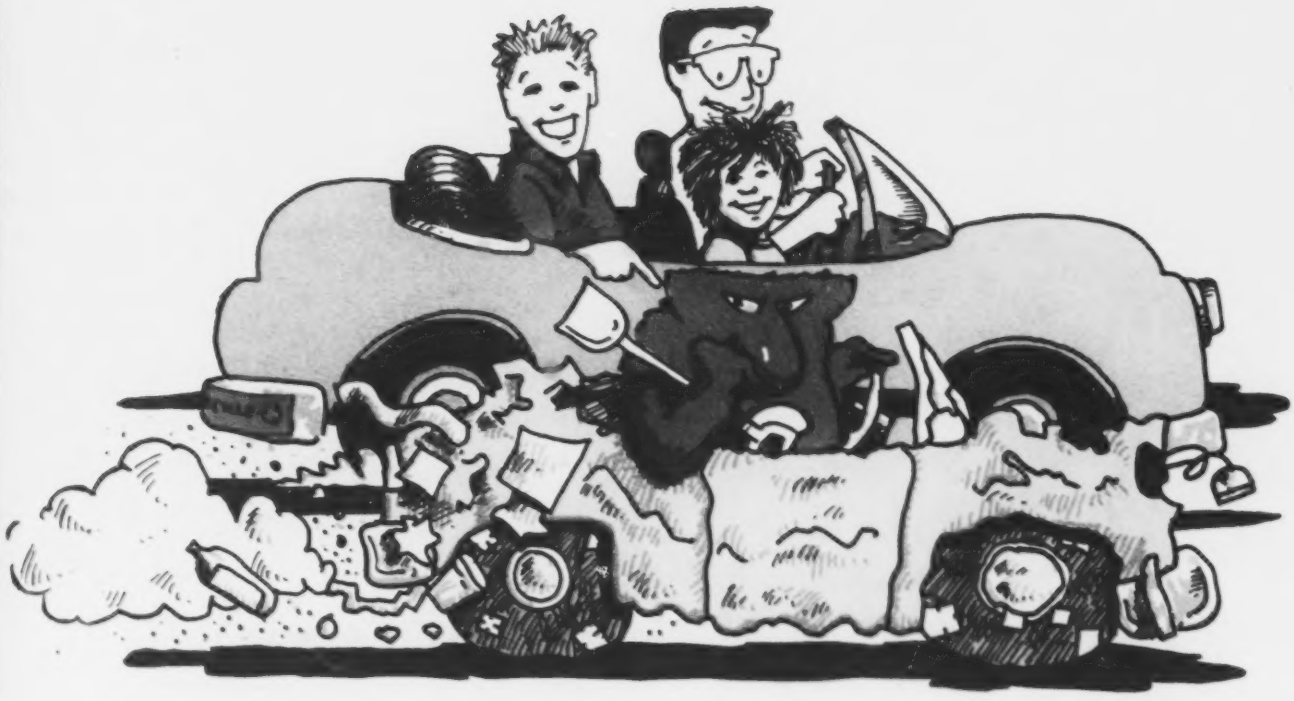
Objective:
To allow children to present what they have learned about recycling to the school and/or community.

Organize a play or a fair (or both) centered around the theme of recycling and its possibilities. For the fair, you might include exhibits of artwork related to recycling, collages made out of scrap, and inventions made entirely out of recycled materials. You could display drawings showing how recycling works, present information on recycling centers, and show how to prepare materials for recycling (separation, cleaning, etc.). This might also be a good opportunity to perform the skit, "Throwaway Three," at the back of the guide.

If your town does not recycle, this class learning experience could turn into an educational opportunity for your whole community.

Notes:

GRADES 7 - 12



UNIT ONE

What Is Waste?

7 - 12

Objective:
To investigate the origins and vocabulary of waste.

Vocabulary: **waste** **garbage** **trash** **junk** **refuse** **rubbish** **scrap**

Q What is *waste*?

Q What types of waste does an average household produce?

Q Which types are in the greatest quantity?

Q What are some of the other names we have for waste?

Using a good dictionary, look up and discuss the cultural origins of the words *garbage, trash, junk, refuse, rubbish, scrap*, and any other words the students come up with. Have students list the above words in order of their offensiveness.

Q Does this list have any relation to the origin of the various words?

Objective:
To identify the components of waste and their sources.

Have students identify the types of waste that result from the production, consumption, and disposal of a can of beef stew or some other prepared food that students are familiar with, such as a TV dinner or frozen pot pie. Have each student make a list of components and their waste, then call on volunteers to write them on the board one at a time. For the stew, the main components to be traced are the meat, potatoes, tin can, and paper label.

For example: MEAT — beef comes from steers, steers eat grain, grain grows in the earth. Wastes produced — grain waste, manure waste, slaughter waste, table scraps, sewage waste.

Objective:
To familiarize students with the Garbage Gremlin as a representation of our wasteful habits.

Show students the cover of the curriculum guide or photocopy the Clip Art page in the front and distribute. Tell students that the creature driving the beatup car at the bottom of the page is a character known as the Garbage Gremlin. Explain that the U.S. EPA has chosen the Garbage Gremlin to represent our wasteful habits and careless attitudes toward the garbage problem in this country. The Garbage Gremlin is portrayed as a creature who loves garbage and revels in any action that contributes to the evergrowing solid waste heap. On the other hand, anyone or anything that decreases waste makes him furious! He appears throughout this guide, as well as in a number of other U.S. EPA publications.

Discuss with students how the use of a character such as the Garbage Gremlin might help foster a more responsible attitude toward our solid waste problem. Encourage students to use their imagination to think of other possible characters, symbols, or slogans that might accomplish the same purpose.

UNIT TWO
How Do We Manage Our Waste?

7 - 12

Objective:
To explore current methods of waste disposal and management.

Vocabulary: **landfill combustion composting recycling source reduction Department of Sanitation integrated waste management**

Q What is meant by "throwing something away"?

Q Where is away?

Q What do we do with waste in our society? (littering, landfill, waste combustion, composting, recycling)

Elicit from students different methods of waste disposal and management and talk a little bit about each one. Help students understand that *landfill* involves controlled burying of waste in the ground, *waste combustion* means controlled burning of waste for energy recovery, *composting* involves converting food and yard wastes into a material capable of enriching soil, and *recycling* means reusing waste to make new materials. All of these topics are discussed in more detail later in the guide.

Q How does our town manage its residential waste?

If students cannot answer this question, you might want to research it as a class by contacting the *Department of Sanitation* or town planning board or arrange to have a representative from the Department of Sanitation or a town planning official visit the classroom to discuss local waste management options. Ask students to prepare some questions in advance.

You may want to plan a field trip to a local landfill, waste combustion plant, or recycling facility so that students can see firsthand how waste is managed in your community.

Define for students the concept of *integrated waste managment.* Tell them that most communities cannot rely exclusively on one method of waste disposal or management. For example, even if a community combusted most of its waste, the ash would need to be disposed of in a landfill and some materials would not burn. To effectively manage all of a community's waste requires a combination of techniques. The techniques currently available are *source reduction* or reducing the amount and toxicity of waste generated, recycling or reusing waste materials, and waste combustion for energy recovery and landfilling. A plan that combines all of these techniques to safely and effectively handle a community's solid waste is known as integrated waste management.

Objective:
To introduce students to the principles of waste combustion.

Vocabulary: **properties toxic combustors pollution control technologies scrubber filters waste-to-energy**

Note: This activity should take place in a laboratory with the proper equipment, including goggles, bunsen burner, tongs, and a fume hood. If the proper facilities are not available, you should probably skip this activity. **Proper ventilation and safety should be stressed** at the beginning of the lesson. Tell students to be especially careful when burning plastics.

Break the class into teams. Give each team 5 to 10 materials to burn. The items should represent a variety of household waste including food, metal, plastic, paper, etc. For the plastic items, select plastic wrap and/or plastic milk jugs or soda bottles. Do not burn anything that may contain polyvinyl chloride (PVC) or cadmium (yellow or with a yellowish cast).

Prepare a data sheet or a chart for noting the initial weight and residue weight of each item burned, the color of flame and smoke, and the odors produced. You can use the chart on p. 58 to record the *properties* of each item.

After students have filled in the chart, ask the following questions:

Q Do you think any of the smoke produced could be harmful? Why and in what way?

Explain to students that some plastics and certain other materials can produce poisonous, or *toxic*, chemicals when they are burned.

Q Are there ways to make the process less harmful to our health or the environment?

Explain to students that modern waste *combustors* differ significantly from the kind of old-fashioned combustor that their experiment was designed to simulate. Modern facilities use a variety of *pollution control technologies* to greatly reduce the amount of toxic materials given off in smoke. Among these are *scrubbers*, which spray a compound into the smoke that helps to neutralize acid gases, and *filters* that remove tiny ash particles from the smoke. Burning waste at extremely high temperatures is another way of destroying harmful chemical compounds and disease-causing bacteria.

Q What are the advantages of burning waste?

1. **The primary advantage of combustion is that it reduces the amount of waste. Waste combustors shrink garbage up to 90 percent by volume and 75 percent by weight.**

2. **Most combustors and all new *waste-to-energy* facilities create energy through the heat given off when waste is burned. In 1989, modern waste-to-energy facilities generated enough electricity to supply 1.2 million households for a year.**

3. **With the increasing costs of land disposal, combustion is becoming a more economical alternative, even though the costs of constructing a waste-to-energy facility are very high.**

Chart for Recording Properties of Materials Burned

Material	Initial Wt.	Residue Wt.	Flame Color	Smoke Color	Odor
Tissue					
Newspaper					
Plastic Bag					
Plastic Bottle					
Tin Can					
Bread					
Banana Peel					

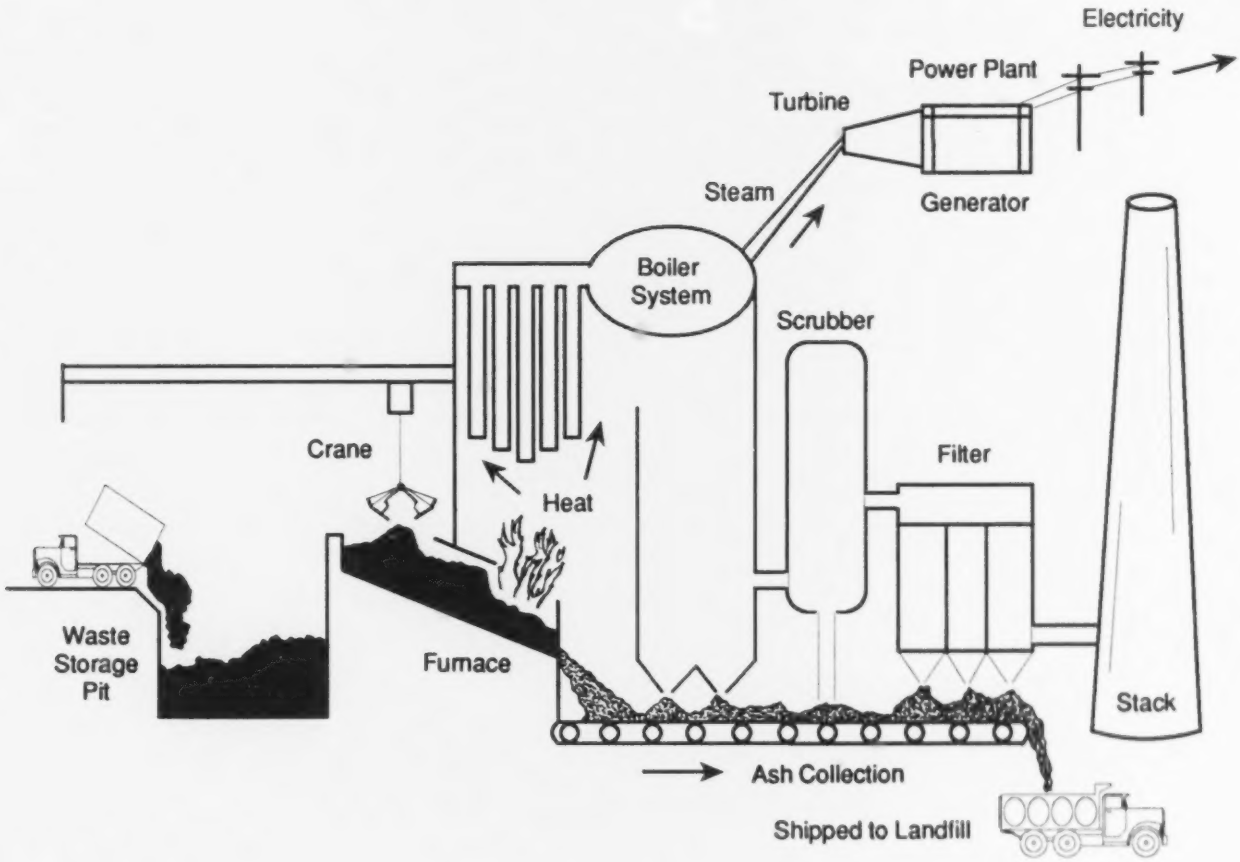
Distribute copies of, or project on an overhead, the diagram of a combustor on p. 60. Help students trace the following steps:

1. **Trucks dump waste into a pit.**
2. **The waste is moved to the furnace by a crane.**
3. **The furnace burns the waste at an extremely high temperature.**
4. **The furnace heats a boiler that produces steam for generating electricity and heat.**
5. **Ash collects at the bottom of the furnace, where it is removed for disposal to a landfill.**

Point out to students that the combustor in the diagram also has two pollution control devices: a scrubber and a fine-particle filter.

Remind students that, as they learned from their experiment, burning does not get rid of all the waste. There is still ash that remains. This ash can be dangerous to the environment, and should be disposed of in a specially designed landfill. One reason that ash can be hazardous is that toxic substances (such as lead in automobile batteries and cadmium in household batteries and some plastic) are more concentrated in the ash than they were in the original garbage. One way to reduce the toxicity of combustor ash is to separate potentially toxic substances from the waste before it is burned. Some of these materials may be able to be recycled. (Refer to Activity 26 for recyclable materials.)

Waste Combustion Plant with Pollution Control System



Objective:
To introduce students to the principles of land disposal.

Vocabulary: leachate wetlands ecosystem

Have students work in pairs to construct mini-dumps. Have each pair cut off the top of a 1-gallon plastic jug and fill it with moist soil. Add small pieces of the following objects: a metal barrette or paper clip, newspaper, plastic, food (apple core, potato peelings), and aluminum foil. Add a little "rain" from time to time.

Explain that the jug represents the way that garbage used to be piled in an open dump. Over the following weeks, periodically examine the objects in the jug to see what, if anything, happens to them. You might want to have students keep a log of their observations or have one log for the whole class.

Over a period of time you can expect the food and newspaper to begin to degrade. (For further discussion of the decomposition process, you may wish to refer to Activities 23 and 24.) The metal will rust. Nothing will happen to the plastic or aluminum foil. Make a chart to display your findings.

Discuss with students why some objects change and others do not. Ask them to think about what implications this has for the environment.

Q How would an uncovered dump like this pollute the environment?

1. **Liquids and metals could leak to the ground-water supply. Students should be able to observe liquid waste collecting at the bottom of the jug. Tell students that liquid waste that comes from a landfill or other solid waste source is called *leachate*. Modern landfills control any leachate that is produced.**
2. **Gases produced by decomposing materials pollute the air, and may even set off fires and explosions if not controlled. Some modern landfills capture this gas and use it as a source of energy.**
3. **Many old landfills were constructed in fragile or unstable environments, such as *wetlands*, earthquake zones, or flood plains, where they posed a threat to *ecosystems* or nearby communities.**
4. **Uncovered dumps produce odors and can be breeding grounds for rats and other disease-causing pests.**

Objective:
To familiarize students with modern sanitary landfills.

Vocabulary: **sanitary landfill** **contaminate**

Tell students that "open dumps" similar to the one they constructed in the last activity are no longer being built. Current methods for building *sanitary landfills* are safer and more protective of the environment. You might begin this activity by asking students if they can think of ways to build a more environmentally safe landfill.

Draw on the board a simplified diagram or distribute copies of the illustration of a model landfill on p. 63. Explain to students that this is an example of one of the more protective landfill designs. Highlight the layers of soil, clay, gravel with collection pipes, plastic liner, and waste. Newly collected waste is covered daily by a layer of soil. Tell students that modern landfills now also control the leachate so that it doesn't *contaminate* the environment.

As a classroom activity, construct a "mini-sanitary landfill" in a terrarium or large glass-bottomed box. Place a variety of wastes (metal, food, paper, plastic) onto the gravel, and cover with a light layer of soil. Sprinkle occasionally with water to simulate rain. Observe changes in the waste materials over time and watch for "leachate" collecting at the bottom.

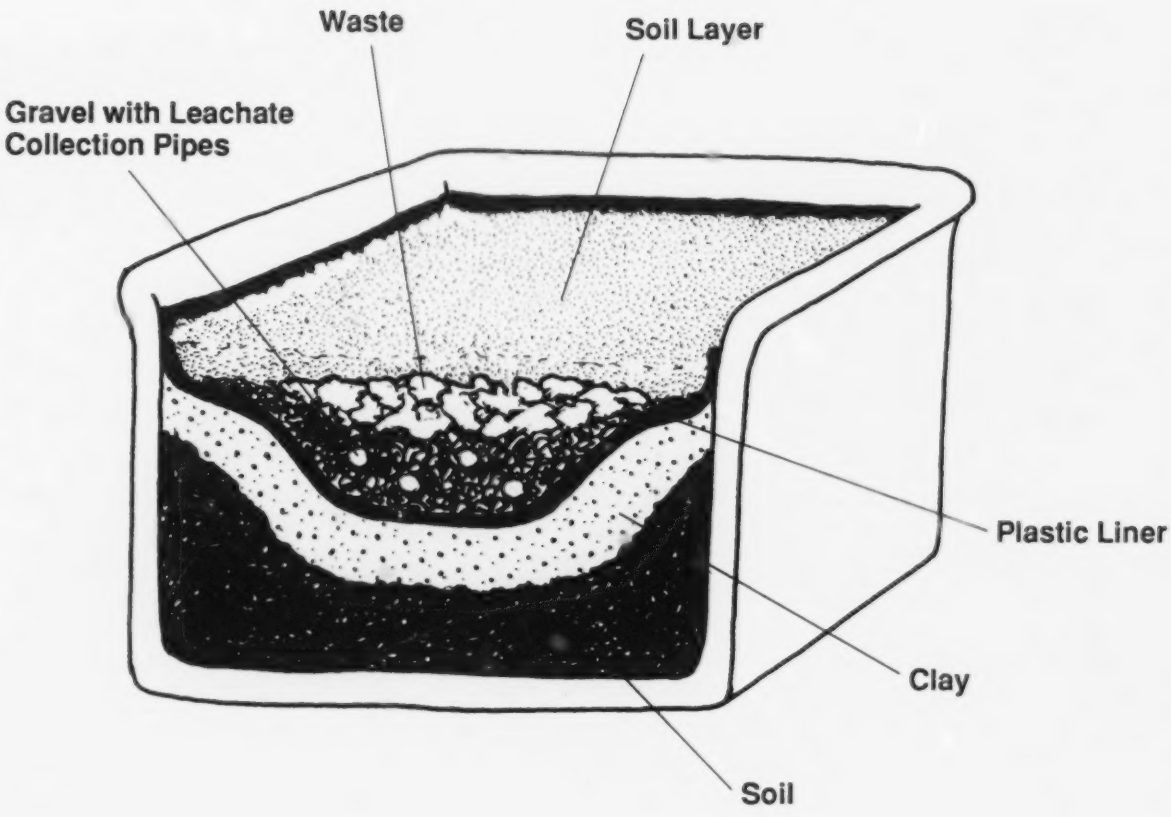
There should be far fewer changes to materials in this modern landfill than there were in the jug.

Q In what ways would it be better if waste was buried in a sanitary landfill—one designed to collect and prevent leachate and to collect gas buildup from decomposition?

Q What problems might still remain?

Q What might happen if we run out of space to create new landfills?

"Bathtub" Model of Modern Sanitary Landfill



Objective:
To sensitize students to the problems of litter.

Vocabulary: **litter**

Discuss litter.

Q What is *litter*? Name some types of litter found on the way to school.

Q What is the most common type?

Q Who are the worst litterbugs?

Q What are the social and environmental costs of litter?

Q How could littering be reduced or stopped?

Organize a litter cleanup at a community park or recreational area. Discuss ways to encourage people not to litter. If cameras are available for student use (or students have their own), encourage students to take pictures of areas of unsightly litter in the community. Create a bulletin board display, labeling the photos with captions describing where the pictures were taken, and what, if any, steps are being taken to alleviate the litter problem. Such a display might even be used at a town meeting or by a community action group.

Objective:
To increase students' awareness of the quantities of waste in their own community and the costs of disposal and management.

Vocabulary: **tipping fees** **true costs**

Discuss with students the types and quantities of waste they throw out in their own homes. As a homework assignment, have the students collect and weigh all the garbage that their household throws out in 1 day. Make sure they include newspapers, writing paper, bags, bottles, jars, cans, food wastes, yard wastes, and packages.

Q How many pounds of garbage does your household throw away each day? (Students will need to weigh bags of garbage at home.)

Q How many pounds does one person in your household throw out in 1 day? (Divide first value by number in the household.)

Q How does this compare to the national average of 4 pounds per person per day?

Q Where else except our homes do we throw things away? (Consider waste generated at school, shopping malls, at a friend's house, etc.)

Find out the population in your community. Based on the amount of waste generated each day by an individual in your household, answer the following:

Q How many tons of solid waste are generated in your community per week, month, and year? (Remind students that 1 ton = 2,000 pounds. You might wish to relate the weight of a familiar object, such as a car, to a ton.)

Q How many tons of garbage do U.S. households throw away each year based on your calculations? (U.S. population = approximately 248 million [1989 projection])

Tell students that an estimated 180 million tons of solid waste are generated in the United States each year. This is enough to fill a convoy of garbage trucks reaching halfway to the moon.

Find out from your Department of Sanitation the waste management costs of 1 ton of refuse. (Landfill *tipping fees* range among communities from $6 to over $100 per ton; tipping fees for

waste combustion range from $20 to over $60 per ton.) These costs may not include the initial capital costs of buying land for building waste facilities or the costs of cleanup of already contaminated areas. The total or *true cost* of waste management is difficult to assess and far exceeds the day-to-day costs of disposal or combustion.

Q Based on the cost of managing 1 ton of refuse, how much would waste management cost your community in 1 year?

Q Where does this money come from? If this cost were divided equally, how much would your household need to contribute to waste management? Is this more than what you are able to save in a year?

To follow up, find out how much the weight and cost of waste management has changed in your community over as many years as records are available. Graph the results to show the increase. You might wish to have students speculate on the costs of waste management in another 10 years, 20 years, etc., based on current rates of increase.

UNIT THREE
How Does Waste Affect Our Resources?

7 - 12

Objective:
To introduce students to the concept of natural resources.

Vocabulary: **natural resource**

List on the blackboard the different materials that compose refuse. Trace each of these back to its original source. (Paper to wood to trees to soil to earth; glass to sand to rocks to earth; metal to rocks to earth; plastic to petroleum to fossil plants to earth; food to animals and plants to earth.) You may wish to refer to the illustration on p. 25.

Investigate where different objects in your classroom come from.

Introduce the term *natural resource* as anything that is supplied by nature that has plant, animal, or human utility.

Q What are the natural resources in the list on the board?

Q Why are natural resources important?

Q Are our resources in endless supply?

Q What will happen if we continue to waste our natural resources by burning, littering, or burying them?

Q Can you think of anything that does not use up natural resources?

Objective:
To introduce the concept of renewable versus nonrenewable natural resources.

Vocabulary: **renewable** **nonrenewable** **aluminum** **petroleum** **bauxite**

Obtain a collection of items that would normally be included in the waste stream. The collection should include examples of products from natural resources that both can and cannot be renewed (or recreated).

Reproduce the "Resource Tree" on p. 69 and distribute to the class.

Using the diagram, have students identify the raw materials used to make each item and decide whether they are *renewable* or *nonrenewable*. In the discussion, point out that *aluminum*, tin, steel, and *petroleum* are all *nonrenewable resources*. Help students to understand that some materials are not renewable because they are the result of geological processes that take millions of years to complete. Nonrenewable resources are in limited supply and once they are used up, they are gone forever.

Paper and cardboard come from the *renewable* source of wood (trees), but wood is being used at a faster rate than it can be produced commercially. At the conclusion of the discussion, students should be able to place any piece of solid waste into the categories of renewable and nonrenewable resources.

Aluminum cans, from *bauxite* (nonrenewable)

Tin-plated steel cans, from iron and tin (nonrenewable)

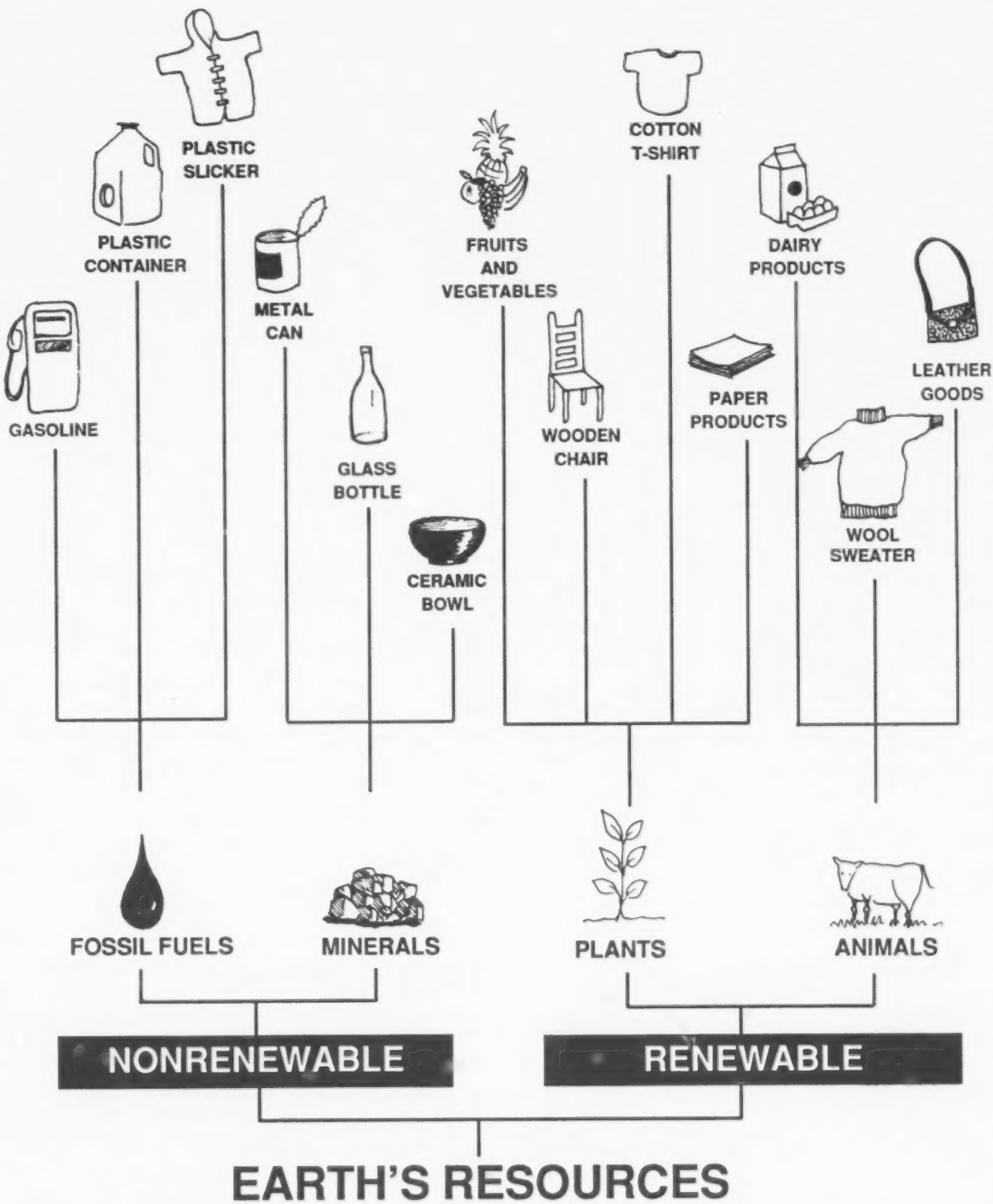
Glass bottles, from sand, soda ash, and limestone (nonrenewable, but in plentiful supply)

Paper, from wood (renewable)

Cardboard, from wood (renewable)

Organic waste, such as plant clippings and food scraps (renewable)

Plastic containers or bags, from *petroleum* (nonrenewable)


PLASTIC SLICKER
PLASTIC CONTAINER
METAL CAN
FRUITS AND VEGETABLES
COTTON T-SHIRT
DAIRY PRODUCTS
LEATHER GOODS
GASOLINE
GLASS BOTTLE
WOODEN CHAIR
PAPER PRODUCTS
WOOL SWEATER
CERAMIC BOWL
FOSSIL FUELS
MINERALS
PLANTS
ANIMALS
NONRENEWABLE
RENEWABLE
EARTH'S RESOURCES

Objective:
To acquaint students with the components of solid waste.

Vocabulary: **municipal solid waste stream**

Reproduce the "pie chart" trash can on p. 71 showing the constituents of the *municipal solid waste stream.*

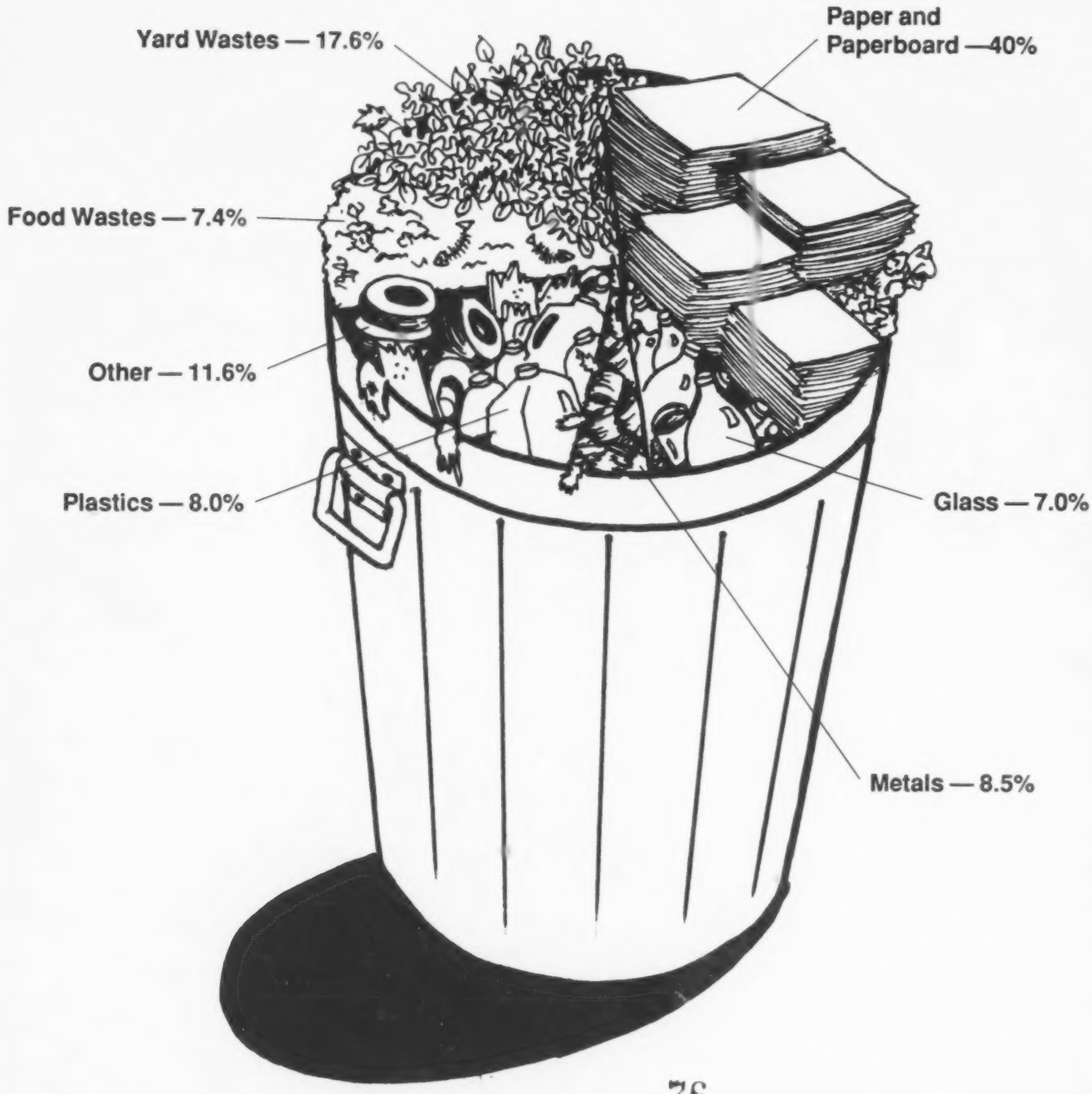
Q What percentage of the total solid waste stream represents nonrenewable resources?

Remind students that the total amount of waste generated by Americans each year is 180 million tons. Based on that figure, ask students to calculate approximately how many tons we generate of each of the materials on the chart.

Have the students imagine the land space required to dispose of these items. Also remember that these are only final products; much more waste is generated in the manufacturing processes for many of these items.

You might want to impress students with the "mind-boggling" statistics in Activity 14 (K-6) or reproduce the Clip Art on p. 12 for distribution to the class.

Materials Discarded into the Municipal Waste Stream*



* Numbers do not add up to 100% due to rounding.

Objective:
To identify the sources of natural resources and gain an appreciation of their scarcity.

Vocabulary: **raw materials** **consumption** **import** **export**

Mount a map of the world on the wall. Have the students list the *raw materials* used to make paper, plastic, metal cans, aluminum cans, rubber, etc. Include oil as the energy source to manufacture these products. (Activity 14 presents a more detailed discussion of energy as a resource.)

Pinpoint the primary source(s) for each material on the map. You may wish to turn this into a short research activity, providing students with encyclopedias or other reference books to locate resource suppliers.

Have students find out the populations of the United States and several other countries (for example, China, India, France, Saudi Arabia, Brazil). Then have them compare resource *consumption* among these countries.

Q What countries do we *import* natural resources from?

Q Does our consumption of resources affect the people in these countries?

Q What resources might we *export* to other countries?

Q What could happen if other countries begin to consume as much as we do?

Q What could happen if available resources begin to run low? What would be the effects on society?

Q How might scarcity of resources affect relationships between countries?

Q How can we begin to lessen our dependence on foreign countries for resources? How might these actions affect individuals in our society?

Discuss solutions including reducing consumption and reusing materials.

Objective:
To explore energy as a resource and discuss different sources of energy.

Vocabulary: **solar** **nuclear** **geothermal** **conservation**

Q Is energy a resource? Why?

Q What sources of energy are available for human use? (Answers may include oil, coal, wind, water, *solar*, *nuclear*, *geothermal*, etc.)

You might want to briefly review any energy sources or processes that students are not familiar with.

> ***Solar*** **- Energy from the sun. Remind students that "solar" energy keeps the earth warm and allows living things to grow. Tell them also that solar energy can be captured and stored so that it can be used to heat air and water in homes and for industrial uses.**
>
> ***Nuclear*** **- The energy that is released when one of the smallest units of matter, the atom, is split. Nuclear energy is used to heat homes and power industry.**
>
> ***Geothermal*** **- Energy captured from the internal heat of the earth.**

Q Are any of these in short supply?

Identify and list the types of energy and points where energy is required in the mining, transportation, and manufacture of glass, paper, plastic, or metal items. Point out that resource *conservation* reduces energy use and that recycling some used materials takes less energy than manufacturing the original product (aluminum and motor oil, for example).

Q What are some of the effects on the environment of producing and transporting different types of energy?

Elicit from students some of the problems associated with energy production:

Offshore oil drilling can pollute coastal waters and can harm marine wildlife.

Oil spills, such as the 1989 *Exxon Valdez* accident, contaminate millions of gallons of water and can harm wildlife.

Dams built to produce electricity change land geography and sometimes make regions more vulnerable to flooding.

Burning coal produces air pollution.

Q What types of energy produce the fewest adverse environmental effects? (Answers may include solar, geothermal, and wind energy.)

Discuss the option of burning solid waste to generate energy and reduce the need for other fuels. Remind students that, as they learned in Activity 5, modern waste combustors generate electricity or steam as they burn garbage.

UNIT FOUR
How Can We Produce Less Waste?

7 - 12

Objective:
To introduce students to the concept of source reduction.

Vocabulary: **source reduction** **toxicity**

Q What comes to mind when you think of sources of pollution? (cars, factories, sewers, litterbugs)

Q Have you ever thought of yourself as a pollution source? In what way?

Elicit from students that whenever they throw something away, they are acting as a pollution source.

Q What do you think the term *source reduction* might mean?

Help students understand that source reduction refers to any activity that reduces waste before it can be generated — at the source. Explain that source reduction involves reducing both the amount and the *toxicity*, or harmful ingredients, of what we throw away. Important source reduction activities include:

Making products last longer.

Cutting down on product packaging.

Substituting nontoxic or less toxic products for those containing potentially harmful ingredients.

Reusing products.

Brainstorm with students on ways they could cut down the amount of waste that they produce at school or at home. Ask them to keep a running list as they work through the activities that follow.

Objective:
To explore historical changes that have contributed to increased waste.

Vocabulary: disposable durable

Call on volunteers to name examples of *disposable* items they have used and list them on the board. Ask students to give specific reasons why they choose certain disposable items over more *durable*, long-lasting products. (cost, availability, convenience, effectiveness, novelty, attractiveness)

Tell students that in 1989, people in the United States threw away approximately 1.6 billion pens, 2 billion razors and blades, and 16 billion diapers.

Q Do you think people living 100 years ago used as many things that could be thrown out after one use? Why or why not?

Elicit from students that people in the past often did not have the choice to buy disposable products. Because there were fewer products available and less variety, people bought what they could find and tried to make them last as long as possible. Advances in industry and technology have made certain products cheaper and easier to mass produce so that it is now sometimes less expensive to buy a new product than to fix an old one. You might ask students whether they have ever encountered this situation.

To answer the question raised above in more depth, investigate the way people lived in your community 50 or 100 years ago. Contact a local historical society or museum, or conduct research in a local library. Based on their research, have students form groups to invent

scenarios of resource use and garbage disposal for a "typical family" from a certain period in the community's history. Students will want to consider food and eating habits, clothing, energy use, cleaning, and recreational activities. Have groups compare their findings with current lifestyles and present what they discover to the class.

In a followup discussion, encourage students to discuss what choices they can make to reduce their use of disposable products and extend the life of things that they already own. Suggestions might include:

Buy reusable products and avoid disposables.

Buy durable products and repair items that can be fixed.

Reuse bags, containers, paper, boxes, and other items.

Borrow or rent things that you don't use very often.

Objective:
To help students appreciate the contribution of packaging to the solid waste stream.

Vocabulary: **packaging efficiency polystyrene bulk quantities**

Packaging materials account for more than 30 percent of all consumer waste. This packaging has increased rapidly over a very short period of time — from 24 million tons in 1960 to 56.8 million tons in 1988. In earlier times, packaging was at a minimum and items were sold in either natural or reusable containers, such as milk bottles which were refilled on a daily or weekly basis. Today, many packages are designed to be disposable, from fruit juice cartons to plastic bubble packs that hold a dozen screws.

Discuss the purposes of packaging. Some of these are reduction in waste due to spoilage, prevention of contamination, increased *efficiency* in distribution, portion control, and product attractiveness.

To demonstrate how lifestyles affect the amount and types of packaging used, have the students make up a typical meal. List all the containers and packaging that come with the items. Remember a glass bottle or can is a package. An example of such a meal might be:

Chicken — clear plastic over *polystyrene foam* plate

Carrots — plastic or paper bag, or box if frozen

Milk — waxed cardboard carton

Rice pilaf — cardboard box, one or more plastic packages

Cookies — plastic container or box with inner wrappers

Q What purposes do the packages from the meal we've selected serve? (preserve food, hold liquid, keep components of a product together, convenience, visual appeal)

Q Are any of these products overpackaged? Can you give some examples of overpackaging? (gum wrappers with each stick double wrapped and a box enclosing the entire package, individually boxed servings of drinks or snacks, microwave or TV dinners)

Q Can you suggest some alternative packaging for your imagined meal? (use of refillable containers, buying in *bulk quantities*, fewer layers of packaging, juice concentrates)

Q What kinds of packaging have changed and which have remained the same over the last few years? (Juice, milk, and soda containers have changed from glass to plastic; cereal boxes and salt containers have remained relatively unchanged.)

Q Are there any examples of packaging actually being reduced? (Some manufacturers have begun to offer detergent in concentrates, more products are available in bulk quantities, bouillon cubes have replaced some canned stock, many juices are now available in frozen concentrates.)

Ask students to speculate about why packaging practices may have changed. (to reduce the amount of waste generated, attractiveness, to make product stand out from others, in response to consumer demands for convenience, health and safety reasons)

Q Explain to students that in addition to looking at the *amount* of product packaging, they should also consider whether the packaging materials can be recycled.

Q Which of the packages chosen for your imagined meal could be recycled or could be made from recycled materials? (cardboard boxes, plastic or glass beverage containers)

Objective:
To explore options for reducing packaging.

Send students on a survey of their local supermarket looking for examples of the following three types of packaging:

1. **Natural packages (oranges, nuts)**
2. **Older and reusable packages (paper bags, paper wrapping, glass jars that become drinking glasses, returnable bottles)**
3. **Modern packages (plastic, polystyrene, tin foil, individual wrappings)**

Ask students to list five examples from category 1, five from 2, and ten from 3. Compile their findings and make a combined list for the entire class.

Q What purpose does the packaging serve for each of the items on the list?

Q How dependent is the product on the package?

Q How could each package be reused or recycled?

Q What alternate packaging could be used that is more environmentally sound?

For each item on the list, decide which packages create excessive waste and which minimize waste.

Discuss some other packaged products students might find in a grocery store. Have students distinguish between products that must be packaged the way they are, and ones that could use less packaging. Initiate a discussion of what students could do to promote the use of less packaging when they shop. Elicit from them that they could buy only products that have no unnecessary packaging and contain no materials that could be harmful to the environment. They could also bring some of their own containers (for bulk cereals, nuts, etc.) from home or reuse shopping bags. Emphasize to students that buying products in bulk quantities produces less waste.

Suggest to students that they write to product manufacturers or store managers to encourage them to make or to stock items that use less packaging. You might also want to choose one particular manufacturer, and write a letter as a class.

Objective:
To introduce students to the idea that certain types of waste can be reused.

Vocabulary: **junkyards** **antiques**

Have students think about the different kinds of things people throw away.

Q Where did the used items at scrap or *junkyards* and *antique* stores come from? What might there be in one person's trash that might be a treasure to others? Relate any personal experiences with such discoveries.

Q Has anyone in the class sold scrap metals, used appliances, or furniture for money?

Emphasize that many things that we throw away have value and can be reused.

To practice reuse in the classroom, hold a clothing drive or toy collection and donate what you collect to a local Goodwill or Salvation Army.

Ask students to think of other ways in which waste could be used rather than disposed of. Briefly discuss with students the possibility of recycling certain materials such as bottles, plastic, soda cans, and newspapers.

Q What can we do with yard wastes such as grass clippings and raked leaves?

Elicit from students the idea that yard wastes can be composted to produce fertilizer that enriches and improves the consistency of poor soils.

Note: Further discussion of **recycling** begins with Activity 25. **Composting** is discussed in more detail in Activity 24.

Objective:
To explore options for reducing the toxicity of products.

Vocabulary: **household hazardous waste** **green products**

Ask students to identify some household products that contain ingredients that may be harmful to their health or to the environment. Household batteries contain lead and cadmium, which are both toxic elements. Other examples are turpentine, drain cleaner, chlorine bleach, flea repellent, mothballs, bug spray, air fresheners, and chemical fertilizer. Discuss with students the problem of disposing of these *household hazardous wastes*. Help them to understand that these products should not be thrown away in the trash to be landfilled or combusted because the poisonous components could contaminate the environment. Instead, many communities hold special collection drives or have dropoff centers to coordinate the safe disposal of household hazardous wastes. If there is one in your community, take students to see how it is run. (**Note**: Do not allow students to run such a collection themselves.)

Emphasize to students that an important way to reduce the problem of household hazardous waste disposal is to use less-toxic products. Explain that nontoxic substitutes exist for many of the products named above. Baking soda, lemon juice, and vinegar are a few common items that can be used instead of many toxic cleaners.

Have students conduct the following experiment to demonstrate the use of a nontoxic substitute for silver polish. If possible, conduct this activity in a laboratory equipped with stations for pairs of students.

Boil 2 to 3 inches of water in a shallow pan with 1 teaspoon salt, 1 teaspoon baking soda, and a sheet of aluminum foil. Submerge a piece of tarnished silverware in the solution and boil for 2 to 3 minutes. Use a cloth to wipe away tarnish. Repeat the procedure if tarnish remains.

Emphasize that all of the ingredients they have just used are safe and can be found in their own homes. For some grade levels, you may want to conduct this activity in conjunction with a chemistry unit on ion exchange.

Have students research the use of nontoxic substitutes as alternatives to toxic products. Local organizations such as chapters of the League of Women Voters and local conservation commissions may be able to provide you with information about toxic products and lists of alternatives.

Tell students that the term *green products* is often used to refer to products that are "environmentally friendly" — don't harm or unnecessarily pollute the environment. Here are some examples of toxic products and nontoxic substitutes:

Turpentine — Use water with water-based paints instead

Drain cleaner — Plunger; boiling water mixed with baking soda

Flea repellent — Garlic, brewers yeast; herbs such as fennel and rosemary

Mothballs — Cedar chips or herbal sachets

Bug spray (ants and roaches) — Lines of chalk or charcoal dust, talcum powder, and cayenne peper; borax

Air fresheners — Baking soda, fresh flowers, herbs

Chemical fertilizer — Compost

Remind students that they can also reduce the amount of toxic material they throw away by purchasing reusable products, such as rechargable rather than disposable batteries.

Have students compile their findings into a bulletin board display or a fact sheet for distribution to the school or community. They might also create a promotional brochure or poster for a local household hazardous waste collection.

UNIT FIVE
What Can We Do About Waste?

7 - 12

Objective:
To introduce students to the concept of natural cycles, and how they can be disturbed.

Vocabulary: **natural cycle** **nutrient** **photosynthesis** **carbon dioxide** **greenhouse effect** **acid rain**

Ask students to describe what is meant by a cycle in nature. Elicit examples of *natural cycles* from students and write them on the board. Discuss the following natural cycles with students.

Nutrient Cycle

1. **Plants take up *nutrients* from soil to make sugar.**
2. **Animals eat plants and return nutrients to soil through body wastes.**
3. **Plants and animals die and decay, returning nutrients from decaying parts to the soil.**

Oxygen Cycle

1. **Plants give off oxygen as a waste product of *photosynthesis*.**
2. **Animals take in oxygen for respiration.**
3. **Animals exhale *carbon dioxide* (CO_2).**
4. **Plants use CO_2 for photosynthesis.**

Water Cycle

1. **Sun evaporates water from oceans and lakes.**
2. **Cooled water vapor forms clouds.**
3. **Clouds release water as rain.**
4. **Plants and animals use water.**
5. **Water not used runs into lakes and oceans or seeps into the ground.**

Mineral Cycle

1. **Matter is continually being built up into mountains and then eroded into sediment.**
2. **New mineral matter is vented from volcanos while other minerals are returned to the earth's interior.**

Q Can you give any examples of ways these natural cycles are disturbed by human beings?

Oxygen Cycle. Too much CO_2 in the atmosphere may contribute to the *greenhouse effect.* CO_2 and other gases in the upper atmosphere act like a pane of glass in a greenhouse, trapping heat and reflecting it back to earth, causing a gentle warming. This warming could cause catastrophic changes in the earth's temperature. Excess carbon dioxide comes from the burning of fuels such as coal, oil, and natural gas; as well as the destruction of vast regions of forest, such as the rain forests in South America.

Water Cycle. Air pollutants react with sunlight and water vapor in the earth's upper atmosphere to form acidic compounds. These compounds then fall to the earth as rain or snow during storms, or with dust or other dry particles in the air. This *acid rain* damages both plant life and soil.

Objective:
To demonstrate the principles of the water cycle.

Vocabulary: terrarium condensation

To illustrate the water cycle, make or show students a *terrarium*. The following materials are needed: glass container with an airtight top, gravel, soil, and various types of small plant life.

Once the terrarium is in operation, have the students observe the water droplets clinging to the top.

Q Where does this water come from? Is it necessary to ever add water to a terrarium?

To further illustrate *condensation*, point out to the students that when the weather is cold they "see their breath." This is due to water vapor being released as we exhale warm air and condensing on contact with colder air. The same process is involved in cloud formation. Steam is another example.

Objective:
To demonstrate the nutrient cycle.

Vocabulary: fungi bacteria

To illustrate the nutrient cycle, divide the students into groups and have each group take a soil profile by digging out a wedge of soil about 4 to 6 inches deep. Select a location where there are freshly fallen leaves. Have students observe the layers of leaf breakdown into the rich topsoil by peeling off each layer.

Q What other things besides leaves can you find in the profile that might hasten decay? Look closely.

Explain to students that plant material is returned to the soil by the action of *fungi* and microscopic *bacteria.* These organisms are vital links in nutrient cycles.

Conduct the same type of investigation using a rotting log.

Q How do its "inhabitants" hasten decay?

Explain to students that the group of organisms called fungi include mushrooms, toadstools, and molds. Together with bacteria, they feed on organic matter, breaking it down, and converting it into nutrients that can then be used by plants.

Objective:
To introduce students to the principles of composting.

Vocabulary: composting windrows

Explain to students that *composting* is a process by which plant material is returned to the soil, as it is in the nutrient cycle. The composting process enriches and improves the consistency of the soil while reducing the amount of solid waste requiring disposal.

Have students make and investigate their own compost operation.

1. **Place the following or similar food wastes in a plastic bag or outdoors in a marked area: apple peels, leaves, old bread, coffee grounds, green tops of vegetables, potato peels. Meat and grease should not be included.**

2. **Chop and mix them up with some water and yard waste such as leaves or grass clippings.**

3. **Twist and tie the bag securely, or cover the mound with earth.**

4. **Open the bag once a day to allow oxygen inside. Explain that oxygen is needed by the microscopic organisms to break down the materials.**

Discuss what is going to happen. (Wastes will begin to decompose, and to grow uniform in color and texture.) Have the students keep a record of the process of decay. Note odors, texture, and other changes.

Q Which materials decay the fastest?

Q How long does the complete decay process take?

Prepare a wet-mount microscope slide and stain to microscopically examine the organisms involved in the process of decomposition.

Q How many different types of organisms can be found?

Q What would our landscape look like if these organisms did not exist?

Q What objects would not decay if placed in our compost pile?

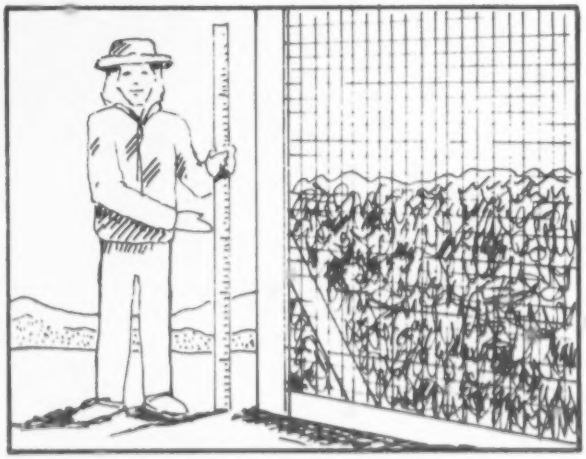
You might want to try using the compost generated to fertilize a garden at the school and monitor its growth.

Ask students if their households have ever kept compost piles of yard or kitchen wastes. Have them discuss their experiences. Tell students that some cities use large composting operations to process a portion of their residential waste. Most often yard waste from the entire community is collected with the local trash pickup and laid out in elongated piles or *windrows*. The windrows are turned periodically and the compost is used by residents in their yards and gardens, or by landscapers on golf courses, along highways, or in local parks.

Encourage students to start their own compost piles at home with their parents' permission. Photocopy the illustration on p. 88 and distribute to the class. Go over the simple set of instructions and have students study and discuss the picture. (For more information about composting, refer to the Community Compost Education Program materials in the Resources section.)

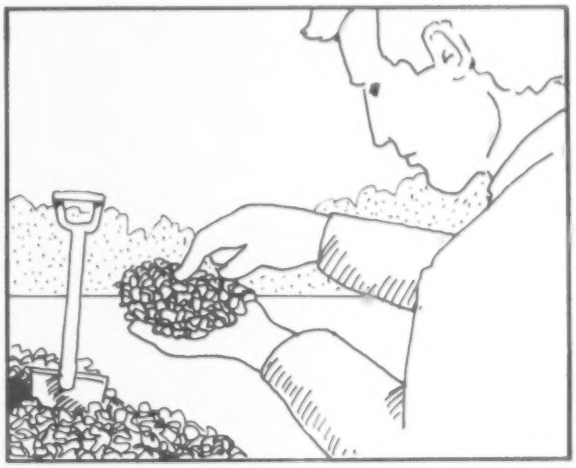
Steps to Backyard Composting

1. Spread a layer of leaves, grass, weeds, or straw inside an enclosed area. Add food wastes, garden refuse, and/or animal wastes. Avoid meat scraps, fats, and oils.

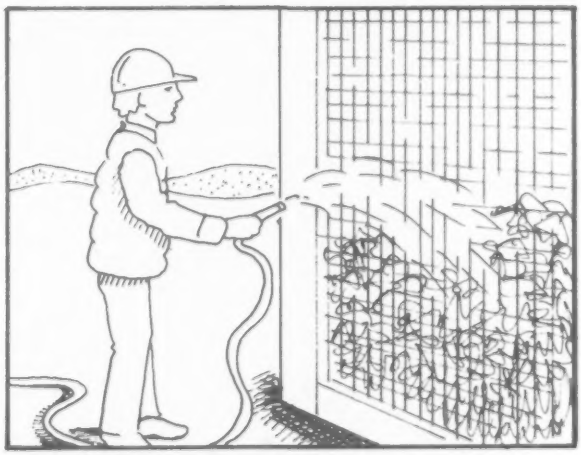


2. Layer the materials to a depth of 5 to 10 feet.

3. Sprinkle with an inch or two of soil, and moisten with water.



4. Turn the pile occasionally to circulate air and distribute moisture.



5. When pile no longer heats up, it is ready to use. Compost should be dark and crumbly.

Objective:
To acquaint students with the meaning of the word "recycle" and the recycling symbol.

Vocabulary: **recycle** **recycleable**

Write the word *recycle* on the board. Ask students to break up the word into its parts: RE-CYCLE.

Q What does the prefix "re" mean?

Q What are some other words that begin with that prefix? (Examples: repair, redo return, resource, renew, restore.)

Q What does the word "cycle" mean?

Elicit from students the meaning of the word *recycle*: to do or use over and over again. Considering what they have learned about natural cycles, ask students how the word recycle might apply to our use of resources.

Explain to students that although we can greatly reduce the amount of waste we generate, some waste materials will continue to be produced. Many of these, however, can be remade into useful products. Have students name some waste materials that can be recycled. Show students the recycling symbols below. Explain that the three arrows of the symbol represent the three stages necessary to recycle materials: collect, remake, reuse. Tell students that products made of recycled materials may have the symbol on a black background displayed somewhere on the package. Products made of *recyclable* materials, materials that could be recycled, display the symbol against a white background. Ask students if they have ever purchased any products that they know were made of recycled materials.

Made of Recyclable Materials

Made of Recycled Materials

Q How can recycling reduce pollution and the cost of waste disposal?

Objective:
To review solid waste problems and learn how glass, paper, plastic, used oil, aluminum, yard waste, and tin-plated steel cans are recycled.

Vocabulary: **cullet** **ore** **caustic** **pulp** **fibers** **electrolysis** **ingots**

Discuss the sequence of steps in recycling the following materials.

Glass is made from soda ash, sand, and lime. It can remain in a disposal site indefinitely and does not break down into its organic components. To be recycled, it must first be sorted by color and crushed into small pieces called *cullet*. The cullet is melted down into a liquid and then molded into glass containers. Other products made from recycled glass bottles are insulations and road-construction materials.

Aluminum is made from *bauxite*, an *ore* that must be mined from the ground. It takes a great amount of electricity to produce aluminum. Nature cannot decompose or break it down, so disposal is a problem. When recycled, aluminum is melted and then shaped again into new cans and other items. Making aluminum cans from old aluminum takes only 5 percent as much electricity as making cans from bauxite.

Tin-plated steel cans are made of iron ore and tin, both nonrenewable resources. The cans will eventually rust and break down, but throwing them away is a waste of valuable metals. In the recycling process, the cans are put into a huge container with holes in the bottom. This container is immersed in a *caustic* solution which dissolves the tin from off the cans. Then the steel cans are washed and sold as high grade steel. The dissolved tin is then removed from the caustic solution by *electrolysis* and made into *ingots* which are then sold to companies requiring tin.

Paper is made from trees. Paper is recycled by first shredding it into small pieces and mixing it with water. This mixture is beaten into a mush-like *pulp* which flows onto a moving screen through which most of the water passes. The wood or paper *fibers* remain. The fibers are pressed through heavy rollers that remove more water and then sent through steam-heated dryers. The result is recycled paper. You can make recycled paper in class (see instructions in K-6 section of guide, Activity 26).

Plastic is made of petroleum. It can be recycled either as a mixture of different kinds of plastic or as a single type. Separating plastic by type enables manufacturers to produce higher quality recycled products, or those closer to what could be produced from virgin materials. Polyethylene terephthalate (PET) (soft drink containers) and high density

materials. Polyethylene terephthalate (PET) (soft drink containers) and high density polyethylene (HDPE) (milk containers) are the plastics most commonly used in beverage containers and the types most easily separated. In the recycling process, plastics are melted down and reshaped into the recycled products. Some of the common uses for recycled PET are fiber, structural molding, and containers. HDPE can be recycled into bottles, toys, pipes, crates, and a variety of other products. Products of mixed batch plastic recycling include garbage pails, car stops, manhole covers, park benches, plastic "lumber," and railroad ties.

Used motor oil collected from people who change their own oil (do-it-yourselfers) can be recycled safely and effectively. It can either be cleaned and used as fuel to be burned in asphalt plants or cement kilns, or it can be rerefined and used again as motor oil. The process of rerefining used motor oil is much cheaper and easier than processing virgin oil.

Yard waste, such as grass, leaves, shrubs, and tree clippings, can be collected and composted by individual households or on a community-wide level. The composting process is described in Activity 24. The compost product from large-scale processing can be distributed to the community as fertilizer for landscaping, gardens, or agricultural uses.

In this activity, students research the "life cycle" of a particular type of waste. Break students into groups and assign one of the types of waste listed below to each group. Reproduce and give each student the questionnaire on the following page to help them tell about their particular resource.

Aluminum Can

Plastic Tube

Cardboard Box

Tin Can

Glass Bottle

Have the groups present their findings to the class. They should make use of drawings, models, or other visual aids and try to make the presentation as informative and entertaining as possible. Older students may wish to make a film or videotape showing the life cycle of their chosen object. These films could be shown to the class or combined in a presentation to the entire school.

THE STORY OF THE _____

1. What does it look like?
2. Why does it have a label?
3. What are some of the things it is used for?
4. What is it made of?
5. Where does the manufacturer get the raw materials to make it?
6. Are large amounts of these raw materials available?
7. How many years will it be before these raw materials run out?
8. Does the process of extracting these raw materials from the earth pollute the land, the air, or the water? If so, how?
9. How do manufacturers change the raw materials to make the product?
10. Does the changing of the raw materials pollute the land, the air, or the water? If so, how?
11. Is the item thrown away after it is used?
12. What effect would this item have if it was littered on the ground or in a body of water?
13. What chemicals are released when it is burned? Are they harmful if released into the environment? Can they be filtered and disposed of properly?
14. Does the item break down into earth again if it is buried? If so, how?
15. Does it disintegrate if thrown into a river, lake, or ocean? If so, how?
16. What are some ways in which it could be reused?
17. Can it be recycled? Is it currently recycled? Where?
18. How is it recycled?
19. Can it be safely burned to produce energy from heat?
20. Who pays the real cost for manufacturing this item?

    The manufacturer who makes it?

    The company that uses it?

    The consumer who buys it?

21. Who is responsible for disposing of it? Who pays the cost for disposal?
22. Do you think this item makes a good container? Why or why not?
23. Could we have avoided using this container? How?

Objective:
To investigate a common manufacturing process, its use of resources, and its production of waste.

Vocabulary: **post-consumer waste**

Visit a papermill or glass manufacturer that produces the products that become our solid waste. Try to find one that uses *post-consumer waste* that has been collected for recycling in the manufacture of its products. Arrange a question and answer session with a representative from such a factory who will talk to students about how recyclable materials contribute to their manufacturing process.

Objective:
To encourage students to design a system to separate recyclables.

Vocabulary: **commingled** **materials recovery facility**

Tell students that sometimes recyclables are not separated before they are collected, but must be separated before they can be recycled.

Q How might a batch of mixed recyclables be efficiently categorized and separated?

Point students in the right direction by having a short discussion about the various physical properties of paper, tin-plated steel, glass, plastic, and aluminum. For example, steel is magnetic; glass is heavier than plastic and aluminum. Then have students use their imaginations to devise a mechanical system for separating these materials out of the solid waste that comes from a home.

You might want to have a contest to design the best separation process, and have students present their inventions to the class through drawings and explanations. After a "winner" has been chosen, explain to the class that there are actually operations called *materials recovery facilities* (MRFs), which some communities use to separate *commingled* recyclables — a mix of recyclable materials. If you can locate one in your vicinity, arrange a field trip so students can observe the process firsthand.

Objective:
To involve students in a classroom or community-wide recycling effort.

Have your classroom recycle its wastepaper and/or other recyclable materials. Coordinate with recycling programs in the community so as not to duplicate their efforts. If one exists in your area, arrange a visit, so that students can see firsthand how one is run.

Call local government agencies or look in the Yellow Pages of your telephone directory under *recycling programs*, *waste paper*, or *scrap dealers* to find markets for your paper, aluminum, glass, plastics, tin cans, or other recyclables. (Refer also to the list of State Solid Waste Agencies in the back of this guide.) Be sure to ask exactly what kind of materials the market will accept (for example, for a paper collection: newspapers, magazines, white bond paper, etc.) so that material collected can be properly recycled.

When you have determined what kinds of materials you will collect for recycling, set up collection boxes so that students can separate their classroom waste and possibly bring in recyclables from home. Emphasize the need to remove labels or clean containers to be recycled as required by the market. The brochure, "School Recycling Programs: A Handbook for Educators," available through U.S. EPA (see Resource list at the back of this guide), contains step-by-step "how to" information on setting up and carrying out different kinds of school recycling programs, from a one-time drive to a long-term effort for the entire school system or a community-wide effort.

Have the students record the weekly or monthly results of their program. Record and graph the reduction in solid waste disposed of through old systems and the amount of glass, paper, cans, or other materials recycled.

The program can also be a money maker, especially with certain materials, such as aluminum. Follow and record the fluctuations in the selling price of the recycled materials. Research the reasons behind these changes. Calculate total money earned by your recycling program. You may want to hold a competition between grades for most money earned or greatest quantity of waste recycled. You might also have students keep a running tally of the number of trees they have saved by recycling paper. Every ton of paper recovered for recycling saves 17 trees from being cut down to make new paper.

Encourage the students to tell their parents about recycling and to bring in recyclables from home.

Objective:
To calculate how much money a community could save by recycling.

Besides reducing pollution and saving natural resources and energy, your community can save money by recycling. Using the figures from your school or classroom recycling program, estimate how many tons of solid waste have been recycled. (You might need to start by having students weigh specific quantities of different recyclables, such as a box of plastic bottles and a bag of tin cans, and then multiply by the number of each that have been collected for recycling.)

Use the information on tipping fees in your community to estimate how much money has been saved. (For example, if tipping fees are $30 per ton and you have recycled 10 tons of materials, you will have saved the community $300 in disposal and management costs.) Add to this amount, the total that you have earned from selling your recyclables to various markets to estimate your community's potential savings. Remind students, however, that the cost of running a recycling program will reduce the community's savings to some degree.

Note: In some areas, the cost of collecting recyclables and a lack of markets could make recycling more expensive than other waste management methods. Recycling still yields net benefits, however, because it saves energy and natural resources, reduces pollution, and conserves landfill space.

Discuss with students ways the community could make more widespread use of recycling (for example, curbside pickups, better publicity, more programs at schools or community centers). Allow them to speculate on how much money their community could save by recycling 25 percent of its solid waste (or more) using the estimate of total waste generated from the Community Profile.

Objective:
To explore attitudes toward recycling and buying products made from recycled materials.

Have the students survey at least three different people concerning their attitudes toward recycling to get an idea of the differences of opinion that exist. They should interview their friends, parents, and neighbors on issues such as whether or not they would be willing to source separate their garbage (for example, setting newspapers in stacks apart from other waste), so it could be more easily recycled.

If your class has access to video recorders or film equipment, encourage them to film their interviews for a class screening. The films can stimulate discussion about the reasons behind people's attitudes, and might also inspire a "documentary" for possible presentation to the entire grade level or school.

Sample Survey Questions

1. **Would you recycle your waste? At home? In the office?**
2. **Why would you recycle? Why not?**
3. **What would encourage you to recycle?**
4. **Which aspect of recycling is most important to you?**
   Saving money?
   Reducing pollution?
   Reducing the need for additional combustors or sanitary landfill sites?
5. **Are you willing to buy products made from recycled materials? Why or why not?**

When the interviews are completed, make a chart on the board and tabulate the results. Calculate percentages of responses to certain questions and prepare the material in the form of a newspaper article or fact sheet.

Based on the answers to question 3, you might wish to discuss with students how they could make a recycling program more attractive to the community.

Objective:
To involve students in the waste management decision-making process.

Explain to students that decisions about waste management are complex because people have different perspectives on the same problem. Everyone, however, has the opportunity to present his or her viewpoint before a decision is made.

Tell students that they are going to consider an imaginary situation in which a county must decide to change its method of waste management. Hand out the fact sheet on p. 99 that presents three different waste management options. Allow time for students to read and study it. You may want to have them work in small groups to come up with their list of specific issues and concerns. When students have finished, hold the following discussion.

Q What different groups in the community would be affected by the decision?

Elicit from students the following categories of community members (and/or others) and write them on the board:

Farmingtown Residents
Busy City Residents
County Real Estate Developers
Environmental Activists
City Merchants
Manufacturers
City Political Leaders
Waste Haulers

Discuss with students the concerns of each of these groups and encourage them to hypothesize what option members of each group might favor. Be sure to include in your discussion such factors as:

1. **Proximity**. People who live close to a proposed site may have concerns about noise, odor, pollution, traffic, or spoiling of landscape that a facility may cause. Residents or land owners who may lose their properties to the construction of a facility will be particularly upset.

2. **Economic Impact**. Developers may be concerned that property that they are considering building on will decrease in value because of the facility. Merchants may worry that the nearness of a facility will make an area less attractive to tourists and people who come from neighboring towns to shop. Manufacturers will be interested in ensuring that they can continue to dispose of their waste in the most cost-effective manner possible. To a lesser degree, all County residents will also be affected by rising costs of waste disposal.

3. **Social/Environmental Issues**. Environmental groups will be concerned about the effects of facilities on the surrounding environment, including the loss of parkland or open spaces for wildlife. Community members may also worry about the County's image and desirability, as well as the potential industrial growth that could follow the construction of a major waste management facility. There may also be widespread concern about perceived sanitation problems at a landfill or air pollution resulting from a combustor.

4. **Legal and Political Concerns**. Different government agencies will have a variety of concerns, depending upon their areas of responsibility. For example, one agency may have concerns about air quality, another about health, still another about trade and commerce in the County. There are also guidelines to consider in the construction of facilities, and varying costs involved in building and regulating them. Political decision-makers need to balance the needs and desires of all the groups in the community in order to ensure public support.

Be sure you introduce into the discussion the idea of long-term versus short-term solutions to the waste problem.

When you feel the issues have been covered satisfactorily, ask students to write down the option that they would choose, along with a paragraph defending their choice. Then call on volunteers to present their arguments to the class. Allow for the possibility that some students may try to modify the original options by proposing a combination of management techniques, including source reduction or recycling.

FACT SHEET

Background Information

Approximately 25,000 people live in Pleasant County: 10,000 live in Busy City, 1,200 live in Farmingtown, and 1,300 live outside in surrounding residential and rural areas. The County has always hauled its trash to nearby Fillup County, but the landfill has reached its capacity and is scheduled to close later this year. Pleasant County, therefore, needs to find an alternative for managing its waste. Various proposals for solutions to the problem are presented below:

1. Pleasant County could construct a major sanitary landfill on farmland adjacent to Farmington. This land would need to be purchased from local growers with federal grant money and would probably take care of the County's waste for the next 40 or 50 years. This is the least expensive option to County residents.

2. The County could construct a waste-to-energy combustion plant just outside of Busy City limits. The property to be purchased includes part of a public park that is used for recreation by the city residents. The combustion plant would be more expensive than the landfill but would continue to take care of a majority of the County's trash for the indefinite future. Some of this money would come from a federal grant; the rest would come from increased garbage collection costs. It would also require the exploration of markets for recyclables that could not be burned efficiently or safely. In addition, some additional costs would be necessary to cover hauling of ash to a landfill in Faraway State. This is the second least expensive option.

3. The County could raise garbage collection fees considerably and haul all of its waste to Faraway State. This option could also include a provision that County residents would pay by weight for the amount of garbage they had hauled away each week. Faraway State's landfill has enough capacity to receive Pleasant County's garbage for another 10 to 15 years. This would be the most expensive option for users of the waste hauling service.

A variety of groups in the community—residents, developers, politicians, merchants, people in business and industry, environmental organizations, health organizations, farmers, waste haulers, construction engineers—all have particular concerns that they would like to see addressed by decision-makers. Considering what you have learned about waste management and what you know from your own experience, write down as many of these concerns as you can.

Objective:
To determine the availability of products made from recycled materials in the marketplace.

Vocabulary: **consumer demand**

Have students make a survey of products in a supermarket or department store that are made from recycled materials. Tell them to look for the recycling symbol on boxes and other containers. Review the symbol with them if necessary.

Discuss the results of their survey. Then have students research why there aren't more recycled materials in the marketplace.

Q Are there any reasons that consumers or manufacturers may prefer to use new materials instead of recycled ones? (The technology may be expensive; there may be some limitations in the strength or appearance of some recycled materials; there may be a lack of a stable supply of materials.)

Q Is there anything we can do to get more recycled products on the market?

Explain that the more we recycle and request products made from recycled materials, the more recycled materials will begin to appear. The key to success in recycling is *consumer demand*. Emphasize that consumers need to use their buying power to choose products made from recycled materials. The more consumer demand there is for products made from recycled materials, the more industry will need to respond to that demand. Suggest to students that they request stores where they shop to carry more products made from recycled materials.

Q Are people willing to buy products made from recycled materials if they are competitive in price and quality?

Q Why do we all need to buy as many products made from recycled materials as possible whenever they are available?

Objective:
To conduct a debate on the pros and cons of the returnable versus the no-deposit, no-return bottle.

Vocabulary: bottle bill

Have students imagine that a *bottle bill* — legislation requiring that all beverage containers sold be returnable and a deposit refunded — is being considered in their town. Divide the class into two teams to research and debate the issue of the returnable container (may be glass, aluminum, or plastic) versus the no-deposit, no-return one. Have one side argue in favor of the returnable container; the other, in favor of no-deposit, no-return.

Some issues the teams may want to consider are:

1. The effect the returnable bottle would have on a recycling program. (Pro: Bottle bills have proven effective in increasing beverage container collection and reducing litter; Con: Most of the revenue obtained from recycling by curbside collection programs is from aluminum and other beverage containers. A bottle bill would remove most of this fraction from the available recyclables.)

2. The effect of mandatory returnable bottles on wholesale and retail marketers, and industry. (Pro: Returnable bottle program could create jobs, provide economic incentives; Con: Marketers would need to implement new, possibly costly procedures.)

3. The effectiveness of bottle collection for recycling versus mandatory return in reducing the volume of the waste stream. (Pro: Bottle bills reduce litter and reduce the number of containers entering the waste stream; Con: In some areas with bottle bills, returned bottles are not required to be recycled, and some bottles collected for recycling end up in landfills rather than recycling plants; beverage containers represent a fairly small percentage of the waste stream so a comprehensive recycling program that *included* beverage containers might be more effective than a bottle bill by itself in reducing waste.)

Objective:
To explore the contributions that business and government can make to the recycling effort.

Discuss ways that businesses and the government can contribute to the solution of the solid waste problem. For example, many businesses and commercial enterprises recycle their office paper, corrugated cardboard, glass, and aluminum. The U.S. EPA has a program to recycle all of its office paper and newspaper.

Q Do businesses in your community recycle their paper?

Perhaps older students can conduct a survey of local merchants and businesses to determine the amount and types of waste they produce and whether they are currently doing any recycling. Supermarkets or chain stores are a good place to start since many of them bale and recycle their cardboard wastes. Restaurants may also recycle some of their wastes. If a nearby federal government building or a private office building has an office paper recycling program, you may want to plan a class trip to see how it works.

Objective:
To allow students an opportunity to educate the school and community about solid waste management.

Plan a science fair that will present information to the school and community on how to reduce the amount of waste they generate, as well as how to recycle waste from the home and school. Begin by brainstorming with students about the things that they can do to solve the garbage problem based on what they have learned.

The fair can include many of the demonstrations used throughout this guide on the sources of pollution, making recycled paper, setting up a compost pile, and the recycling processes of different types of materials. It can also include displays of how to prepare and separate materials for recycling and booths on shopping and designing packaging for waste reduction. You may wish to have some students put on skits that deal with themes of source reduction and recycling, such as the waste conscious versus the wasteful way to shop

for food, change oil (12th grade), and prepare a meal. This would also be a good opportunity to perform the skit "Throwaway Three," located at the back of the guide.

Encourage your students to think of the fair as a learning opportunity for the entire community.

End of Activities

Notes:

GLOSSARY

Acid Rain - Rain or snow that contains a high concentration of acidity from the reaction of air pollution, primarily sulfer and nitrogen oxides, with sunlight and water vapor in the earth's upper atmosphere.

Air - An odorless, colorless, tasteless mixture of gases that surrounds the earth. Its primary components are nitrogen and oxygen. Every form of life is dependent on *air* for survival.

Aluminum - A lightweight, silver-white, metallic element that makes up approximately 7 percent of the earth's crust. *Aluminum* is used in a variety of ways, but perhaps most familiarly in the manufacture of soft drink cans.

Antique - An object that was made in an earlier period of history, and may have special value because of its age.

Ash - In combustion, solid residue which remains after waste has been completely burned.

Bacteria - A division of spherical, spiral, rod-shaped, or comma-shaped microscopic organisms. Some *bacteria* are responsible for such processes as fermentation and decomposition; others cause diseases such as pneumonia.

Bauxite - A rock in which aluminum is found in high concentrations.

Bottle Bill - A law requiring that the price of a beverage container includes a refundable deposit. The deposit (usually 5 cents) is returned to the consumer when the container is returned to the retailer.

Bulk Quantities - Food or other products that are sold unpackaged or in large containers so that consumers can buy them in large amounts, thus minimizing packaging waste.

Burning - Destroying or breaking down by fire; undergoing combustion.

Carbon Dioxide - A heavy, colorless, odorless gas, present in the atmosphere or formed by the burning of fuels containing carbon. *Carbon dioxide* is also exhaled by animals and used by plants in photosynthesis.

Cardboard - A thin, stiff material made of paper pulp, and used in making cartons and other forms of packaging.

Caustic - The property of one substance that enables it to burn, corrode, or dissolve another substance by chemical reaction.

Combustor - Facility for controlled burning of municipal solid waste to reduce its volume and weight, and, commonly, to produce energy.

Commingled - A mixture of any number of recyclable materials, which usually must be separated before they can be recycled.

Compost - The decomposed organic material resulting from the composting process and used to enrich or improve the consistency of soil for growing.

Condensation - The changing of a gas or vapor to a liquid, as in the formation of water droplets when steam cools.

Conservation - The protection of or wise use of natural resources, such as forests, rivers, and fuels, to ensure their continuation.

Consumer Demand - The persuasive power the buyer of goods exercises on manufacturers by choosing certain products over other ones.

Consumption - The using up of products and resources by consumers.

Contaminate - To make impure or unsafe by contact with potentially harmful substances.

Cost - The price of something; the amount paid.

Cullet - Clean, generally color-sorted, crushed glass used to make new glass products.

Decomposition - The process by which a substance is broken down into component parts or basic elements. Food and other plant and animal matter *decompose* under the proper conditions of light, air, and moisture.

Department of Sanitation - The organization in a city or town responsible for the management of municipal waste.

Disposable - Designed to be thrown away after one use or after a limited period of time.

Durable - Capable of withstanding long use, wear, and decay.

Earth - The planet on which we live, composed of oceans and land masses and surrounded by an atmosphere of gases. Also, the land surface of the world.

Ecological Packaging - A container or protective wrapping for a product that is not toxic and requires little energy and few natural resources for its manufacture. Its disposal also does not produce excessive waste, either in amount or toxicity.

Ecosystem - A system made up of a community of living things and the physical and chemical environment with which they interact.

Electrolysis - The decomposition of a substance that ionizes (separates or changes into positively and negatively charged particles) when an electric current is passed through the solution in which it is dissolved.

Efficiency - The quality of acting or producing effectively with a minimum of waste, expense, or unnecessary effort.

Energy - The capacity for an object or a system to do work. Coal and oil are sources of energy because the heat given off when they are burned can be used to perform work.

Export - To send or carry a product to another country for sale.

Fibers - The long, thick-walled cells that give strength and support to plant tissue. The *fibers* of wood and cloth are used in making paper.

Filter - A material with tiny holes, or pores, through which a liquid or gas is passed to remove impurities or potentially polluting substances.

Fuels - Substances that are consumed to produce energy, such as wood, coal, gas, or oil.

Fungi - A major branch of organisms that absorb their nutrients from dead or living organisms. Mushrooms, yeasts, toadstools, rusts, molds, and mildews are all *fungi*.

Garbage - Originally, spoiled or waste food that was thrown out; now, any material considered worthless, unnecessary, or offensive, and usually thrown away.

Geothermal Energy - The internal heat of the earth that can be used to perform work.

Glass - Hard, brittle, generally transparent or translucent material typically formed from the rapid cooling of liquified minerals. Most commercial *glass* is made from a molten mixture of soda ash, sand, and lime.

Greenhouse Effect - An increase in the earth's temperature resulting from the accumulation of carbon dioxide and water vapor in the atmosphere. Excess amounts of these gases trap heat in the upper atmosphere and reflect it back to earth.

Green Product - A product that is not toxic and requires little energy and few natural resources for its manufacture. Its disposal also does not produce an excessive amount or toxicity of waste.

Household Hazardous Wastes - Products used in the home that contain substances that are listed as or that exhibit the characteristics of hazardous wastes as defined by the Resource Conservation and Recovery Act (RCRA): ignitability, corrosivity, reactivity, and toxicity. RCRA does not require that *household hazardous wastes* be disposed of as hazardous wastes, but caution should be taken to dispose of them so as to minimize the impact to human health and the environment.

Import - To bring or carry in from a source outside of one's own country for trade or sale.

Ingots - A solid piece of metal shaped for convenience in storage or transportation, such as an ingot of steel.

Integrated Waste Management - The complementary use of a variety of waste management practices to safely and effectively handle municipal solid waste. *Integrated waste management techniques* include source reduction, recycling, and combustion and landfilling.

Junk - Material such as glass, rags, paper, or metals that could be made into something usable.

Junkyard - A lot or property where worn out or discarded items, or metal or other scrap material, is stored for possible resale.

Landfill - See *Sanitary Landfill.*

Leachate - Liquid that has percolated through solid waste and/or has been generated by solid waste decomposition, and that has dissolved or suspended materials in it. The liquid may contaminate ground or surface water.

Litter - Waste materials carelessly discarded in an inappropriate place. Littering is against the law.

Litterbug - Someone who throws away waste materials in public areas or other inappropriate places.

Materials Recovery Facility - A system that separates collected mixed residential recyclables by type so that they can be recycled into new products available for market.

Metal - An element that usually has a shiny surface, is a good conductor of heat and electricity, and can be melted down, fused, or hammered. The class of *metals* includes iron, gold, sodium, copper, magnesium, tin, and aluminum.

Mold - A furry textured fungus, often greenish-blue, black, or whitish in color, that appears on food or other organic matter that has been left in a moist place or is decaying.

Municipal Solid Waste Stream - Waste generated in households, commercial establishments, institutions, and light industries. Industrial process wastes, agricultural wastes, mining wastes, and sewage sludge are not part of the *municipal solid waste stream.*

Natural Cycle - A series of events in nature that repeat over and over, usually involving a complete process of growth or action. Examples of *natural cycles* include the oxygen cycle, the nutrient cycle, the water cycle, and the mineral cycle.

Natural Resources - Materials supplied by nature that are useful or necessary for life, such as minerals, water, and wood.

Nonrenewable Resource - Natural materials that are considered finite, or exhaustible, because of their scarcity, the great length of time required for their formation, or their rapid depletion.

Nontoxic - Not containing ingredients that are harmful, poisonous, or destructive.

Nuclear Energy - Energy released when one of the smallest units of matter, the atom, is split. *Nuclear energy* is used to heat homes and to power industry.

Nutrient - A substance that provides food or nourishment, such as usable protein, vitamins, minerals, or carbohydrates.

Open Dump - An uncovered space once used for depositing municipal refuse, and sometimes experiencing health and sanitation problems. These have now been replaced by modern sanitary landfills with designs that contain waste and prevent contamination of surrounding areas.

Ore - A collection of minerals or a rock that contains a high concentration of an economically valuable metal or mineral.

Organism - A living body made up of cells, tissues, and organs.

Packaging - A container or wrapping made out of any of a number of materials and used for storing, transporting, or displaying a product.

Paper - A thin material made of pulp from wood, rag, or other fibrous material and used for writing, printing, or wrapping.

Petroleum - A dark, oily, flammable liquid found in the earth's crust. Gasoline, kerosene, and paraffin are all made from petroleum.

Photosynthesis - The process by which plants manufacture nutrients from carbon dioxide and water in the presence of chlorophyll and light. Oxygen is released as a by-product.

Plastic - A material made from petroleum capable of being molded, extruded, or cast into various shapes. There are many different kinds of *plastic* made from different combinations of organic or petroleum compounds.

Pollution - The contamination of soil, water, or air by the discharge of potentially harmful substances.

Pollution Control Technologies - Equipment designed to reduce pollution and the resulting adverse environmental and health effects from waste combustion or disposal, or private or industrial emissions. Filters are often used to control emissions of particles, and scrubbers can control emissions of acidic gases such as sulfur dioxide and hydrogen chloride.

Polystyrene - A plastic that is easily colored and molded for use in packaging or as a structural material. This material, commonly known by its trade name, Styrofoam, is often used as packaging to insulate takeout or fast food.

Population - The total number of people inhabiting a particular area such as a city, county, country, or the entire world.

Post-Consumer Waste - Residential waste reused in industrial processes; for example, recycled newspapers used to manufacture more newsprint.

Pound - A unit measure of weight equal to 16 ounces or approximately 454 grams.

Product - Something manufactured by hand or by industry for use or purchase by a consumer.

Properties - A characteristic trait or behavior exhibited by a particular substance.

Pulp - A mixture of fibrous material such as wood, rags, and paper, ground up and moistened to be used in making paper or cardboard.

Raw Materials - Unprocessed natural substances, such as wood and metals, used in the manufacture of products.

Recyclable - Material that still has useful physical or chemical properties after serving its original purpose and that can, therefore, be reused or remanufactured into additional products. Plastic, paper, glass, tin and aluminum cans, and used oil are considered *recyclables*.

Recycle - The process of collecting materials from the waste stream and separating them by type, remaking them into new products, and marketing and reusing the materials as new products.

Refuse - Discarded material considered to have no worth or use.

Renewable Resource - A naturally occuring raw material or form of energy derived from an endless or cyclical source such as the sun, wind, falling water (hydroelectric), biofuels, and trees. With proper management and wise use, the consumption of these resources can be approximately equal to replacement by natural or human-assisted systems.

Reuse - The use of a product more than once in its same form for the same purpose or for different purposes. For example, a soft-drink bottle is *reused* when it is returned to the bottling company for refilling; a peanut butter jar may be *reused* in the home as a container for leftover food.

Rubbish - Anything thrown out or discarded.

Runoff - Water or other fluid that is not absorbed by the soil, and so enters streams and other bodies of water.

Sanitary Landfill - A specially engineered site for disposing of solid waste on land, constructed so that it will reduce hazard to public health and safety. Some qualities include an impermeable lower layer to block the movement of leachate into ground water, a leachate collection system, gravel layers permitting the control of methane, and daily covering of garbage with soil.

Scrap - Discarded or rejected industrial waste material often suitable for recycling.

Scrubber - Common antipollution device that uses a liquid or slurry spray to remove acidic gases and particles from municipal waste combustion facility flue gases.

Soil - The top layer of the earth's surface, composed primarily of rock, minerals, and decomposed matter from dead plants or animals. Soil is essential for growing things.

Solar Energy - Heat from the sun that can be used to perform work.

Source Reduction - The design, manufacture, and use of products so as to reduce their amount and toxicity. *Source reduction* measures include reusing items, minimizing the amount of products used, extending the useful life of a product, and reducing the amount of excessive product packaging.

Statistic - A piece of numerical information that shows the measure of a sample.

Steel - A strong durable material made of iron and carbon, and often other metals to achieve different properties. Steel is often used as a component in cans and as a structural material in construction.

Terrarium - A closed container in which small plants and sometimes small animals, such as toads and lizards, are maintained in a controlled environment.

Tin - A soft silver-white metallic element, capable of being easily molded and having a low melting point. *Tin* is often used together with other metals in making cans for packaging.

Tipping Fee - A fee, usually in dollars per ton, for the unloading or dumping of waste at a landfill, transfer station, recycling, or waste-to-energy facility.

Ton - A unit of measure equal to 2,000 pounds or 907.2 kilograms.

Toxic - Producing or containing a poisonous substance that may be harmful or deadly.

Trash - Material considered worthless, unnecessary, or offensive that is usually thrown away. Generally defined as dry waste material; excludes food waste and ashes. The term is often used interchangeably with the word garbage.

True Costs - The total sum required, in addition to daily or apparent costs. The *true costs* of waste management include the initial costs of building treatment or disposal facilities and cleaning up already contaminated areas, in addition to the day-to-day costs of running the facilities.

Valuable - Having monetary value or useful qualities.

Waste - Material that has been discarded because it has worn out, is used up, or is no longer needed, such as packaging, newspapers and used writing paper, and broken appliances. Many things thrown out as *waste* may have the potential to be recycled or reused.

Waste-to-Energy Plants - Combustors that convert heat from the combustion of raw municipal waste into steam, which can be used to provide power for homes and industry.

Water - A colorless, odorless, tasteless liquid that is essential to plant and animal life. In the form of oceans, water covers 70 percent of the earth's surface.

Waxed Cardboard - A material used in packaging made of thin paperboard coated with a shiny, waterproof surface, usually plastic. *Waxed cardboard* is often used in making cartons, such as for milk and orange juice. It is not easily recycled.

Wetlands - A lowland area, such as a marsh or swamp, saturated with water. *Wetlands* are considered crucial wildlife habitat and are considered important for flood control and maintaining the health of surrounding ecosystems.

Windrows - A large, elongated pile of yard and/or food waste used in the composting process. Municipal composting programs often use *windrows* for large-scale composting of yard waste.

THROWAWAY THREE

A short skit

By Fay Bradley

Reprinted from "Lessons from Litter" by permission of the Atlanta Clean City Commission.

"Throwaway Three" is a skit in rhyme written for three actors. To involve a larger number of students, a different person may be used for each of the ten roles.

Each part has three notations beneath it. The first is the character's date in history. Make signs for each of these dates and have one person hold up the appropriate sign at the appropriate time in the skit. The second notation is the name of the character (Monkey, Cave Dweller, etc.). The third notation describes the props. These include both the costume for the person in history and the articles thrown away.

The central idea is that as the skit progresses, each person throws more trash on the pile in the middle of the room so that a high stack is created. The skit suggests that one way to solve the problem is to recycle. A discussion of ways to solve the problem of too much garbage and trash might follow the performance.

PROP LIST:

monkey masks
banana peel
orange peel
skins
Roman helmet
bag of trash
sack of trash
Pilgrim hat
quilt
coonskin hat
leather harness or belts
engineer's cap
three sweaters: one handmade, two machine made
lab coat
nylon stockings
plastic bags and containers
perma-pressed shirt
TV dinner
small broken appliance
toy car
Indian headband
cola bottle
clear bottle
flower

THE THROWAWAY THREE

Person 1

This is the tale of the Throwaway Three
Of humans and garbage throughout his-to-ry:
Now they're very nice people, just like you and me,
Who all have a problem, as you will soon see —
What shall they do with their garbage and trash?

All:

Why, throw it! Or bury it! Or burn it to ash!

Person 2
90,000 BC
(Monkey)

I represent people when we lived in a tree.
I get rid of my garbage so easily!
It's a snap! It's no problem — to me, or to him.
We just let it go, plop! Down through the limbs!

Props:

(Monkey masks, banana peel, orange peel)

Person 3
50,000 BC
(Cave Dweller)

I am a Cave Dweller who lives on the ground.
What do I do with old stuff all around?
Why bury it like bones, in the muck and the mire.
Or burn it with leftover skins in the fire.

Props:

(Skins)

All

Yes, throw it, or bury it, or burn it to ash!
That's how we *always* get rid of our trash!

Person 1
200 BC
(Roman)

I am a Roman who lives in the town.
Our laws won't allow me to just throw it down.
I have to drag it away for a mile
And then I can dump it, forget it, and smile!

Props:

(Roman helmet, bag of trash)

Person 2 **1200 AD** **(Briton)**	I am a Briton, wary and quick; Down on our street it can get pretty thick, When housewives above want to pitch out their goo, They just heave it out here and yell "Gardy-loo!" (Person 1 stands on chair and yells "Gardy-loo!") It will stay in the alleys until the next rain, Or until our fair London should burn down again.
Props:	(Sack of trash)
All	Oh, what do we do with our garbage and trash: We throw it, or bury it, or burn it to ash!
Person 3 **1630** **(Settler)**	I am the settler. I came without much, Oh, a rifle, an axle, a few tools and such. But everything else I must make with my hands. So I don't throw out much —I use all I can. Cloth scraps become quilts; I reuse my bent nails. It will be a long time 'fore the next trade ship sails.
Props	(Pilgrim hat, quilt)
Person 1 **1700** **(Colonist)**	I am a colonist; now life's not so tough. We have trade between cities that brings lots of stuff And some things are made by our townfolk today, I could buy a new harness, throw this old one away. We have pigs and hogs running loose in our street, If I toss it out there, they'll eat it up neat! Or I might bury it right over there. Or I could burn it; no one would care. You see, the New World is the same as the Old! We trashmakers come from a time-honored mold.
Props:	(Coonskin hat, leather harness or belts)
All	What do we still do with garbage and trash? Right! Throw it or bury it or burn it to ash!

Person 2
1890
(Industrialist)

I'm the industrialist and new on the scene,
I mass-produce goods with my trusty machine.
This sweater, handmade, took a week, even more,
But now in one hour, I can make forty-four.
I make things so cheaply, you can now afford two,
And throw out twice as much as you used to do.

Props: (Engineer's cap, three sweaters: one handmade; two machine-made)

Person 3
1950
(Scientist)

I am the scientist in the new post-war age.
We've learned a few tricks while the war shortage raged.
When we couldn't get natural stuff to process
We invented synthetics to replace the rest.

Props: (Lab coat)

Person 2
(Industrialist)

Rayons and nylons, acrylics and plastics
For furniture and clothing and even elastics;
Discard your old woolens and silks and your cotton;
Real wooden toys and washboards are forgotten.

Props: (Nylon stockings, plastic bags and containers)

Person 3
(Scientist)

Our new stuff will last till forever, you see
Even when it's worn out to you and to me.
Permanent pressed, pre-sized and pre-shrunk,
When dingy and old, it's still permanent "junk."
(Person 1 yells, "Junk.")

Props: (Perma-pressed shirt)

Person 2
(Industrialist)

We make instant menus that come in a pack.
You just boil the food in its own plastic sack.
Or heat our TV dinner in its tinfoil tray
It's quick; you don't wash it; just throw it away!

Props: (Plastic bag, TV dinner)

Person 3 (Scientist)

We make lots of TVs and clothes dryers, too.
Don't ask for a trade-in; you're kidding, aren't you?

Props:

(Small broken appliance)

Person 2 (Industrialist)

Our new cars all change with each model year,
Don't try to repair them, the cost's much too dear.
Besides, we don't bother to make last year's parts
For Skylarks or Novas or Cougars or Darts.

Props

(Toy car)

Person 3 (Scientist)

It's the New Thing, the NEW that America craves.
So out, out with the old stuff, away to their graves.

Person 2 (Industrialist)

So what if there're more of us buying more goods?
So what if they won't rot away as they should?

Person 1 (Indian)

Now wait just a minute! You cannot fail
To include me in your historic trash tale.
We Indians lived simply, on prairies, in woods,
We made no high trash piles, nor mass-produced goods.
Let me be your critic, show you where you stand;
And tell you just how you're defiling our land.
Your new-fangled goods will not rot away.
When you throw them all down they remain where they lay
Then you say you will bury them deep in the ground:
All your urban trash will make quite a mound!
So then you would burn it, in smoldering masses
And fill up our air with smoke, deadly gases!
Oh, all of your answers have faults everywhere:
You'll ruin the water, the land or the air.
What's more your resources — your lumber, your ore —
Get smaller each year than the year just before.
And what's more — this old earth's not making any more.

Props:

(Indian headband)

Person 2 **(Industrialist)**	You're right. Our resources are shrinking away While our garbage problem grows bigger each day. We're always converting resources to refuse Instead of recycling them all for reuse!
	(Throw out cola bottle)
Props:	(Cola bottle)
Person 3 **(Scientist)**	Oh stop it! Don't drop it! We'll think of a way To make food for cows that's much better than hay. Don't burn it, return — we'll make something new, A vase for your mother, a spyglass for you. Don't bury it, carry it —back to the mill. We'll make a new blanket to ward off the chill.
	(Pick up old quilt and wrap around shoulders.)
Props:	(Clear bottle, flower) (Flower in bottle for vase, flower out, bottle held up to eye for spyglass)
Person 2 **(Industrialist)**	It's time to progress past the Disposal Age And make recycling the popular rage! We'll have to give up old solutions for trash And all realize that its pure balderdash — to just
All	Throw it, or bury it, or burn it to ash!

END

DISCUSSION

The skit shows the students that people have historically gotten rid of solid waste successfully by throwing it out, burying it, or burning it. But none of these methods solves modern urban garbage problems. The discussion should attempt to reinforce this concept. One way this can be done is to discuss the characters in the skit: how they disposed of their garbage or trash and why their method of doing so was either satisfactory or not satisfactory.

Monkey: Threw it down.
No problem developed because no large concentration of monkeys existed.
The garbage disintegrated.

Cave Dweller: Threw it, burned it, buried it.
These acts still did not cause a problem for the same reasons.

Roman: Threw it.
Tossing out garbage began to be a problem because many people moved to the cities, thus producing more trash than they could get rid of in the city.

Briton: Threw it.
A problem grew because more and more people moved to the cities, thus producing more trash than they could get rid of in the city.

Settler: Had virtually no garbage.

Colonist: Threw it, burned it, buried it.
Greater trade resulted when people did not use goods until they wore out, but then discarded things began to accumulate.

Industrialist: With a greater concentration of people in cities than ever before and more buying because machine-made goods were cheaper, much more was thrown out.

Scientist: The big change to synthetics plus the use of enormous amounts of natural resources are causing tremendous problems.

We can't throw away our trash. There simply is no such place as "away." Care is always required to prevent our trash from having bad effects on our lives.

We can't bury it all. Not enough places are available. Besides, the modern synthetics do not rot when buried.

We can't burn it all. Some of the synthetic goods simply won't burn. Most of the burning requires expensive and often elaborate controls to prevent air pollution. And there is always ash or something left over which must be buried.

We are literally running out of some natural resources so that any form of disposal of certain goods is self-defeating.

STATE SOLID WASTE AGENCIES

Alabama
Department of Environmental Management
Solid Waste Division
1751 Congressman Wm. Dickinson Drive
Montgomery, AL 36109
205-271-7700

Alaska
Department of Environmental Conservation
Solid Waste Program
P.O. Box O
Juneau, AK 99801
907-465-2666

Arizona
Energy Office
1700 W. Washington Street
Phoenix, AZ 85017
602-542-3633

Arkansas
Department of Pollution Control and Ecology
Solid Waste Division
8001 National Drive
Little Rock, AR 72204
501-562-7444

California
Recycling Division
Department of Conservation
1025 P Street
Sacramento, CA 95814
916-323-3743
800-642-5669

Colorado
Department of Health
4210 E. 11th Avenue
Denver, CO 80220
303-331-4830

Connecticut
Recycling Program
Department of Environmental Protection
165 Capital Avenue
Hartford, CT 06106
203-566-5847

Delaware
Department of Natural Resources and Environmental Control
89 Kings Highway
P.O. Box 89
Dover, DE 19903
302-736-4794

District of Columbia
Department of Public Works
Office of Policy and Planning
2000 14th Street NW
Washington, DC 20009
202-939-8115

Florida
Department of Environmental Regulation
2600 Blair Stone Road
Tallahassee, FL 32301
904-488-0300

Georgia
Department of Natural Resources
205 Butler St., SE
Atlanta, GA 30334
404-656-2833

Hawaii
EPHS
Department of Health
P.O. Box 3378
Honolulu, HI 96801
808-548-6410

Idaho
Department of Health and Welfare
State House
Boise, ID 83720
208-334-5879

Illinois
Dept. of Energy and Natural Resources
325 West Adams
Springfield, IL 62704
217-524-5454

Indiana
Department of Environmental Management
105 S. Meridian Street
Indianapolis, IN 46225
317-232-8883

Iowa
Department of Natural Resources
Waste Management Division
900 E. Grand Avenue
Des Moines, IA 50319
515-281-8176

Kansas
Solid Waste Management Section
Department of Health and Environment
Forbes Field
Topeka, KS 66620
913-296-1594

Kentucky
Department of Environmental Protection
Cabinet for Natural Resources and Environmental Protection
Fort Boone Plaza, Bldg #2
18 Riley Road
Frankfurt, KY 40601
502-564-6716

Louisiana
Solid Waste Division
Department of Environmental Quality
P.O. Box 44307
Baton Rouge, LA 70804
504-342-1216

Maine
Waste Recycling and Reduction
Department of Economic and Community Development
State House Station #130
Augusta, ME 04333
207-289-6800

Maryland
Department of the Environment
201 W. Preston Street, Room 212
Baltimore, MD 21201
301-225-5647

Massachusetts
Division of Solid Waste Management
Dept. of Environmental Protection
1 Winter St., 5th Floor
Boston, MA 02108
617-292-5589

Michigan
Recycling and Recovery Unit
Department of Natural Resources
P.O. Box 30038
Lansing, MI 48909
517-373-2730

Minnesota
Pollution Control Agency
520 Lafayette Road, North
St. Paul, MN 55155
612-296-7282

Mississippi
Pollution Control Bureau
Department of Natural Resources
P.O. Box 10385
Jackson, MS 39209
601-961-5047

Missouri
Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102
314-751-1492

Montana
Solid and Hazardous Waste Bureau
Department of Health and Environmental Sciences
Cogswell Building, Room B201
Helena, MT 59620
406-444-2821

Nebraska
Department of Environmental Control
P.O. Box 94877
Lincoln, NE 68509-8922
402-471-2186

Nevada
Department of Conservation and Natural Resources
Capitol Complex
201 South Fall Street
Carson City, NV 89710
702-687-4670

New Hampshire
Department of Environmental Services
6 Hazen Drive
Concord, NH 03301
603-271-4662

New Jersey
Department of Environmental Protection
401 E. State Street
Trenton, NJ 08625
609-292-0331

New Mexico
Health and Environment Department
P.O. Box 968
Santa Fe, NM 87504
505-457-2780

New York
Bureau of Waste Reduction and Recycling
Department of Environmental Conservation
50 Wolf Road, Room 209
Albany, NY 12233
518-457-6603

North Carolina
Solid Waste Management Branch
Department of Human Resources
P.O. Box 2091
Raleigh, NC 27602-2091
919-733-2178

North Dakota
Division of Waste Management
Department of Health
1200 Missouri Avenue, Room 302
Box 5520
Bismarck, ND 58502-5520
701-224-2366

Ohio
Division of Solid and Hazardous Waste Management
Ohio Environmental Protection Agency
1800 Watermark Drive
P.O. Box 1049
Columbus, OH 43266-0149
614-466-7220

Oklahoma
Solid Waste Division
Department of Health
1000 N.E. 10th Street
Oklahoma City, OK 73152
405-271-5338

Oregon
Department of Environmental Quality
811 S.W. 6th Avenue
Portland, OR 97204
503-229-5356

Pennsylvania
Bureau of Waste Management
Department of Environmental Resources
P.O. Box 2063
Harrisburg, PA 17120
717-787-9870

Rhode Island
Department of Environmental Management
204 Cannon Building
75 Davis Street
Providence, RI 02908
401-277-2797

South Carolina
Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201
803-758-5681

South Dakota
Department of Water and Natural Resources
523 E. Capitol
Foss Building, Room 416
Pierre, SD 57501
605-773-3153

Tennessee
Department of Public Health
Division of Solid Waste Management
Customs House, 4th Floor
701 Broadway
Nashville, TN 37219-5403
615-741-3424

Texas
Division of Solid Waste Management
Department of Health
1100 W. 49th Street
Austin, TX 78756-3199
512-458-7271

Utah
Bureau of Solid and Hazardous Waste
Department of Environmental Health
288 N. 1460 West Street
P.O. Box 16700
Salt Lake City, UT 84116
801-533-4145

Vermont
Department of Natural Resources
103 S. Main Street, West Building
Waterbury, VT 05676
802-244-8702

Virginia
Department of Waste Management
Monroe Building, 11th Floor
101 N. 14th Street
Richmond, VA 23219
1-800-KeepIt
804-225-2667

Washington
Office of Waste Reduction
Department of Ecology
Mail Stop PV-11
Olympia, WA 95804-8711
1-800-Recycle
206-459-6316

West Virginia
Department of Natural Resources
1260 Greenbriar Street
Charleston, WV 25311
304-348-5935

Wisconsin
Bureau of Solid Waste Management
Department of Natural Resources
P.O. Box 7921
Madison, WI 53707
608-266-1327

Wyoming
Solid Waste Management Program
Department of Environmental Quality
Herschler Building
122 W. 25th Street
Cheyenne, WY 82002
307-777-7752

RESOURCES

All EPA publications can be ordered by calling the Resource Conservation and Recovery Act (RCRA) Hotline at 1-800-424-9346.

EPA Educational Materials

Recycle Today! A series of publications developed in conjunction with this curriculum for teachers and students:

Adventures of the Garbage Gremlin: Recycle and Combat a Life of Grime. 1990. (EPA/530-SW-90-024). A comic book introducing students in grades 4-7 to the benefits of recycling.

Recycle Today! An Educational Program for Grades K-12. 1990. (EPA/530-SW-90-025). A concise pamphlet explaining the goals and objectives of EPA's educational recycling program and the four resources available.

Ride the Wave of the Future: Recycle Today! 1990. (EPA/530-SW-90-010). A colorful poster designed to appeal to all grade levels that can be used in conjunction with recycling activities or used to help foster recycling.

School Recycling Programs: A Handbook for Educators. 1990. (EPA/530-SW-90-023). A handy manual with step-by-step instructions on how to set up a school recycling program.

Other EPA Solid Waste Publications

America's War on Waste. 1990. (EPA/530-SW-90-002). An environmental fact sheet describing EPA's completed publications, current activities, and future activities related to municipal solid waste management.

Be an Environmentally Alert Consumer. 1990. (EPA/530-SW-90-034b). A handy booklet describing approximately 100 practical steps that consumers can take to reduce the amount and toxicity of the trash they generate.

Bibliography of Municipal Solid Waste Management Alternatives. 1989. (EPA/530-SW-89-055). A listing of approximately 200 publications available from industry, government, and environmental groups, including a section on educational programs/curricula.

Characterization of Municipal Solid Waste in the United States: 1990 Update. Executive Summary. 1990. (EPA/530-SW-90-042A). A summary of EPA's most recent report characterizing the national waste stream and including information on municipal solid waste generation, recycling, composting, landfilling, and combustion.

Characterization of Products Containing Lead and Cadmium in Municipal Solid Waste in the United States, 1970 to 2000. 1989. (EPA/530-SW-89-015c). A technical report characterizing all products that contribute at least 1 percent of the lead and cadmium found in municipal solid waste.

Decision-Maker's Guide to Solid Waste Management (Volume I). 1989. (EPA/530-SW-89-072). A guidebook designed to help decision-makers understand and evaluate their current waste management problems.

How to Set Up a Local Used Oil Recycling Program. 1989. (EPA/530-SW-89-039a). An easy-to-follow manual for local decision-makers, environmental groups, and community organizations.

Methods to Manage and Control Plastic Wastes - Executive Summary. 1989. (EPA/530-SW-89-051a). An overview of a report exploring the environmental, technical, and policy issues related to plastic waste disposal. (Ask the Hotline how to receive a full copy of the report — EPA/530-SW-89-051.)

Office Paper Recycling: An Implementation Manual. 1990. (EPA/530-SW-90-001). A comprehensive guide describing all aspects of how to set up an office paper recycling program, including finding markets, developing a collection system, and educating employees.

Once There Lived a Wicked Dragon. 1974. (EPA/SW-335). Coloring/story book for grades K-3.

Plastic Fact Sheets. 1990. A series of five pamphlets on plastic issues:

The Facts About Plastics in the Marine Environment. 1990. (EPA/530-SW-90-017b). A fact sheet summarizing the main sources and impact of plastic found in the ocean.

The Facts on Degradable Plastics. 1990. (EPA/530-SW-90-017d). A fact sheet outlining the information currently available on degradable plastics, their uses, and impact on humans and the environment.

The Facts on Recycling Plastics. 1990. (EPA/530-SW-90-017e). A fact sheet summarizing the opportunities available for plastic recycling, and the current state of plastic recycling technology.

Plastics: The Facts About Production, Use, and Disposal. 1990. (EPA/530-SW-90-017a). A fact sheet reviewing major uses of plastic and impacts of disposal.

Plastics: The Facts on Source Reduction. 1990. (EPA/530-SW-90-017c). A fact sheet describing the possibilities for source reduction of different types of plastic products.

Recycle. 1988. (EPA/530-SW-88-050). A concise citizen's brochure on recycling and its role in solid waste management.

Recycling Works! 1989. (EPA/530-SW-89-014). A booklet describing 14 successful state and local recycling programs in the United States.

Sites for Our Solid Waste: A Guidebook for Effective Public Involvement. 1990. (EPA/530-SW-90-019). A guidebook for developing a municipal solid waste facility siting strategy that involves the public.

The Solid Waste Dilemma: Solutions for the 90s. 1990. (EPA/530-SW-90-058). A report presenting a national strategy for managing municipal solid waste and describing steps that government, industry, and the public can take to help resolve the problem.

Used Oil Recycling Brochures. A series of three brochures on ways to recycle used oil:

> **Recycling Used Oil: What Can You Do?** 1989. (EPA/530-SW-89-039b). How the general public can participate in used oil recycling.
>
> **Recycling Used Oil: 10 Steps to Change Your Oil**. 1989. (EPA/530-SW-89-039c). How citizens can change their car oil.
>
> **Recycling Used Oil: For Service Stations and Other Vehicle-Service Facilities**. 1989. (EPA/530-SW-89-039d). How service station owners can play a key role in facilitating used oil recycling.

Waste Not, Want Not. 1972. U.S. Government Printing Office no. 055-002-00094-1, $.35 each, $4.50 per 100. Small poster deals with basic conservation issues from putting as little as possible into the garbage can to supporting community recycling programs.

Yard Waste Composting: A Study of Eight Programs. 1989. (EPA/530-SW-89-038). A technical report describing successful composting programs across the country.

Other Selected Educational and Solid Waste Materials

Adventures of Colonel Kentucky. 1988. Kentucky Natural Resources and Environmental Protection Cabinet, Division of Solid Waste Management, 18 Reilly Road, Frankfort, KY 40601. (502) 564-3350. Student workbook and teachers guide on waste education topics.

A-Way with Waste: A Waste Management Curriculum for Schools. 1989. Washington State Department of Ecology, 4350 150th Avenue, NE, Redmond, WA 98052. (206) 867-7000.

Biodegradable, A Science Unit for 4th Grade. 1987. Columbus Clean Community, 181 South Washington Boulevard, Columbus, OH 43215. (614) 645-6179.

Bottles and Cans, Using Them Again. 1977. McPhee, Gribble, Puffin Books. Viking Press, New York. A colorful, well-illustrated booklet that contains many interesting activities involving the reuse of materials to make craft projects.

A Case of Waste. 1986. Health Research Incorporated, Health Education Service, P.O. Box 7126, Albany, NY 12224. (518) 439-7286. $5.

Class Project: Conservation Learning Activities for Science and Social Studies. 1982. National Wildlife Federation, 1412 16th Street, NW, Washington, DC 20036. (202) 797-6800.

Classroom Activities. 1989. Maine Office of Waste Recycling and Reduction, State House Station 130, Augusta, ME 04333. (207) 289-3154. Activities on recycling and solid waste topics for grades K-12.

Community Compost Education Program. 1986. A series of four brochures on home composting. These brochures may be obtained from Seattle Tilth Association, 4649 Sunnyside Avenue North, Seattle, WA 98103. (206)633-0224.

Public Information Packet. Design sheets for five home compost bin systems, a local resource guide, and home composting brochure. $5.

Home Composting Brochure Printing Masters. Camera-ready version of brochure that can be customized for any composting program. $125.

Master Composter Training Manual. Covers essentials of hands-on composting, biology of composting, and how to set up a home composting program. $35.

Home Composting Slide Show. 55 image slide show and script describing techniques for home composting. $75.

Solid Waste, Recycling and Waste Reduction Slide Show. 80 slides depicting solid waste management practices. $90.

Complete Trash (The Best Way to Get Rid of Practically Everything Around the House). 1989. Norm Crampton, M. Evans and Company, New York.

Connections: A Curriculum in Appropriate Technology for the Fifth and Sixth Grades. 1980. Environmental Education Project, Portland State University, P.O. Box 751, Portland, OR 97207.A program designed to teach fifth and sixth graders to recognize and use appropriately-scaled technologies, including recycling. $2.30.

Crackerbarrel Entertainment. 1990. 168 Shore Road, Clinton, CT 06413. (203) 669-6581. Environmental educators and performers with many solid waste programs in their repertoire, which are also available on cassette.

A Curriculum Activities Guide to Solid Waste and Environmental Studies. 1973. Institute for Environmental Education, 8911 Euclid Ave., Cleveland, OH 44106. (216) 464-1775. $15.75. Addresses grades K-12.

Disposal of Household Hazardous Waste: Slide Set. 1989. Cornell Media Services, Audio Visual Resource Center, Building 8, Research Park, Ithaca, NY 14850. (607) 255-2090. $49.

Don't Throw It Away! 1987. Connecticut Fund for the Environment, 152 Temple Street, New Haven, CT 06510. A 32-page booklet on developing a local publicity and public education campaign for recycling.

Don't Waste Waste. 1986. Environmental Action Coalition, 625 Broadway, New York, NY 10012. (212) 677-1601. Curriculum for grade levels 4-6 includes bibliography and list of additional resources.

Eco-News. Environmental Action Coalition. 625 Broadway, New York, NY 10012. (212) 677-1601. A monthly environmental newsletter for young people.

Environmental/Energy Education Program. Tennessee Valley Authority, Knoxsville, TN 37902. (615) 632-6031. Regional network of education centers.

Folksong in the Classroom. 1989. Laurie Seidman, 140 Hill Park Ave., Great Neck, NY 11021. Three-part series on the environment.

Fund-Raising through Recycling: An Events Planning Guide. 1988. Mid America Glass Recycling Program, 29 Purfleet Drive, Bella Vista, AK 72714. (501) 855-4703.

Garbage in America. 1988. Refuse Industry Productions, Inc., P.O. Box 1011, Grass Valley, CA 95945. (916) 272-7289. A complete solid waste management curriculum for Grades K-12.

Garbage Games: Language and Math Games Using Recycled Containers. 1982. Betty Isaak, The Learning Works, Inc., Santa Barbara, CA.

Garbage Reincarnation. 1986. Sonoma County Community Recycling Center, P.O. Box 1375, Santa Rosa, CA 95402. (707) 584-8666. $5.95. Instruction manual for grades K-6.

The Great Glass Caper: An Educational Kit. 1987. Pennsylvania Glass Recycling Corporation, 509 North Second Street, Harrisburg, PA 17101. (717) 234-8091.

Groundwater Protection Curriculum Guide. 1989. Missouri Department of Natural Resources, P.O. Box 176, Jefferson City, MO 65102. (314) 751-3443. Solid waste and related topics for grades 4-12.

A Guide to Curriculum Planning in Environmental Education. 1985. David C. Engleson, Department of Public Instruction, P.O. Box 7841, Madison, WI 53707-7841. (608) 266-3390.

Handbook for Reduction and Recycling of Commercial Solid Waste. 1988. Department of Environmental Management, State of Rhode Island, 9 Hayes Street, Providence, RI 02908. (401) 277-3434.

Here Today, Here Tomorrow: Revisited (Grades 4-8). 1989. Department of Environmental Protection, Division of Solid Waste Management, 401 East State Street, Trenton, NJ 08625. (609) 530-4001.

Household Hazardous Waste Educational Program Kit. 1988. Terry Smith, San Bernardino EPWA, 385 No. Arrowhead Ave., San Bernardino, CA 92415-0160. (714) 387-4646.

Household Hazardous Waste Wheel. 1990. Environmental Hazards Management Institute, P.O. Box 932, New Market Road, Durham, NH. 03824. Tool for learning about household hazardous wastes, their toxic components, and safe alternatives. $3.75. Educator's rate: 10 for $2.25.

If You're Not Recycling, You're Throwing It All Away. 1988. Environmental Defense Fund, 257 Park Avenue South, New York, NY 10010.

Importance of Being a Garbologist. 1979. Group for Recycling in Pennsylvania, rev. ed. Intended for grades 3-6.

Increasing Solid Waste Awareness in the Classroom: Lessons in Resource Recovery. 1986. Genesee County Cooperative Extension Service, G-4215, W. Pasadena Ave., Flint, MI 48504-2376. (313) 732-1474. Lesson plans on recycling, reduction, reuse, and composting.

Indiana Office of School Assistance Curriculum Materials. 1989. Center of School Improvement and Performance, Room 229, State House, Indianapolis, IN 46204-2798.

Recycling Coloring and Activity Book (K-6)
Total Environmental Education (K-12)
Whole Earth Design (4-12)
Hazardous Dumping Ground Module (6-12)
Take Pride in America (K-12)
The Outdoor Classroom (K-6)

Junk Treasures: A Sourcebook for Using Recycled Materials with Children. 1981. Mary Jo Puckett and Jean M. Shaw, Prentice-Hall, Englewood Cliffs, NJ.

The Land We Depend On. 1989. Illinois Environmental Protection Agency, 2200 Churchill Road, P.O. Box 19276, Springfield, IL 62794-9276. (217) 782-3397. Land pollution, solid and hazardous waste topics.

Let's Go to a Recycling Center. 1977. G.P. Putnam's Sons, New York.

Let's Recycle. 1989. Channing L. Bete Co., Deerfield, MA. Cartoon and activities book explaining recycling.

Let's Recycle: Lesson Suggestions for Teachers of K-3. 1977. Recycling Council of British Columbia, 1629 Columbia Street, Vancouver, B.C., Canada. (604) 731-7222.

Let's Recycle! Instructional Worksheets and Activities. 1989. Office of Recycling, Department of Waste Management, Town of Brookhaven, 3233 Route 112, Medford, NY 11763. (516) 451-6220.

The Lorax. 1978. Office of Public Affairs, U.S. Environmental Protection Agency, Region 1, JFK Federal Building, Boston, MA 02203. (617) 565-3187. An animated parable of human wastefulness and destruction of the environment for grades K-12. Videocassette (25 min).

Making a Difference: A Curriculum Process Guide for Community Environmental Problem-Solving Projects. 1981. Resource Recycling, P.O. Box 10540, Portland, OR 97210. (503) 227-1319. $7.50. A stepwise plan for conducting a community problem-solving project, including recycling. Upper grade levels.

Mining Urban Wastes: The Potential for Recycling. 1985. Cynthia Pollock, Elsevier Applied Science Publishers, London.

Operation Waste Watch. 1981. Virginia Office of Litter Prevention and Recycling, Division of Waste Management, James Monroe Building, 11th Floor, Richmond, VA 23219. (804) 225-2667. Litter prevention and recycling curriculum and teachers guides for grades K-6.

Oscar's Options. Vol. 1 and 2. 1987, 1989. Department of Environmental Management, 9 Hayes Street, Providence, RI 02908. (401) 277-3434. Environmental education curriculum for grades 4-8.

Paper by Kids. 1980. Arnold Grummer, Dillon Press, Inc., Minneapolis, MN. History of paper and how to make it by hand.

Project MORE: Meeting Our Responsibilities. 1981. Texas Department of Health, Division of Solid Waste Management, 1100 West 49th Street, Austin, TX 78756-3199. (512) 458-7271. Curriculum on solid waste management topics.

Recycling: Activities for the Classroom. 1978. Mary Lynne Bowman, Herbert L. Coon, ERIC/SMEAC Center, 1200 Chambers Road, 3rd Floor, Ohio State University, Columbus, OH 43212. (614) 292-6717.

Recycling: Games, Science Equipment and Crafts from Recycled Materials. 1976. Robin Simons, Houghton Mifflin Co., 2 Park Street, Boston, MA 02107. (617) 725-5000.

Recycling Education: Developing a Curriculum. 1985. Dan Cotter, P.O. Box 10540, Portland, OR 97210. (503) 227-1319.

Recycling for Reuse. 1985. 4-H Program, University of Wisconsin Extension, 328 Lowell Hall, 610 Langdon Street, Madison, WI 53703. (608) 266-4156.

Recycling Nature's Way. [ ] Alcoa Recycling Center. (614) 899-1183.

Recycling in Your School Makes Good Sense. 1989. Cornell Media Services, Audio-Visual Resource Center, Building 8, Research Park, Ithaca, NY 14850. (607) 255-2090. Slide show for elementary students.

Recycling Study Guide. 1988. Wisconsin Department of Natural Resources, P.O. Box 7921, Madison, WI 53707. (608) 267-5239. Designed for grades 4-12.

Recycling Wheel. 1990. Environmental Hazards Management Institute, P.O. Box 932, Durham, NH 03824. (603) 868-1496. Tool for learning facts about recycling and recyclable materials. $3.75. Educator's rate: 10 for $2.25.

Recycling Study Guide. 1989. New York Department of Environmental Conservation, 50 Wolf Rd., Room 504, Albany, NY 12233. (518) 457-3720.

Recyculum (K-6). 1980. Resource Recovery, P.O. Box 10540, Portland, OR 97210.

Resource Materials for Schools. 1989. Massachusetts Department of Environmental Quality and Engineering, Division of Solid Waste Management, 1 Winter Street, 4th Floor, Boston, MA 02108. (617) 292-5960.

Resource Recovery: Teacher's Aide. 1980. Solid Waste Program, Florida Department of Environmental Regulation, 2600 Blair Stone Rd., Tallahassee, FL 32301. (904) 488-4805. Information on resource recovery suitable for incorporation into curriculum of grades 4-12.

Re: Thinking Recycling. 1988. Oregon Department of Environmental Quality, 811 S.W. 6th Ave., Portland, OR 97204-1390. (503) 229-6046.

Reusable Math. 1987. Pennsylvania Resources Council, Inc. P.O. Box 88, Media, PA 19063-0088. (215) 565-9131. $3.50. Book of recycling related math problems for grades 1-8.

RE/USES: 2,133 Ways to Recycle and Reuse the Things You Ordinarily Throw Away. 1982. Carolyn Jabs, Crown Publishers, Inc., New York, NY.

Rubbish to Riches. 1979. Energy Information Center, Vernon, VT. (802) 257-1416. Film for grades 7-12 showing how waste products are converted into fuel and usable products (11 min).

Solid Waste in Riverside, CT. Connecticut Department of Environmental Protection, Information, and Education Section, 165 Capitol Avenue, Hartford, CT 06106. (203) 566-8108. Role-playing activity involving siting a landfill or trash-to-energy facility.

Space Station: Earth. A Recycling Video Program for 4th-5th Grades. 1986. Solid Waste Management Division, Snohomish County Public Works, 4th Floor, County Administration Building, Everett, WA 98201. (206) 388-3425.

Spreading the Word: A Publicity Handbook for Recycling. 1989. Association of New Jersey Environmental Commissions, 300 Mendham, NJ 07945. (201) 539-7547.

Strength in Numbers: Recycling in Multi-Family Housing. 1987. Association of New Jersey Environmental Commissions, 300 Mendham, NJ 07945. (201) 539-7547.

Super Saver Investigators. 1988. Office of Litter Prevention, Ohio Department of Natural Resources, Fountain Square, Building F, Columbus, OH 43224. (614) 265-6444.

Swimming Upstream: 13 Minute Video. 1988. Solid Waste Management Division, Snohomish County Public Works, 4th Floor, County Administration Building, Everett, WA 98201. (206) 388-3425.

Teacher's Guide: Educational Materials in Resource Recovery (K-12). Cathy A Berg, 1984. EDRS, 3900 Wheeler Avenue, Alexandria, VA 22304. (800)-227-3742.

Teacher Resource Guide. 1988. Vermont Department of Education, 120 State St., Montpelier, VT 05602. (802) 828-3135. Activities on solid and hazardous waste recycling.

Texas Education Agency Curriculum. 1977. 1701 North Congress Avenue, Austin, TX 78707-1494. (512) 463-9596.

Suggested Activities for Environmental Education in the Elementary Schools (K-6).

Suggested Activities for Environmental Education in the Secondary Schools (7-12).

Toys: Fun in the Making. U.S. Department of HEW, rev. ed. 1979. U.S. Government Printing Office order no. OHD-79-30031. Instructs children how to make toys out of common throwaway items, such as toilet paper rolls. Intended for preschool-6.

The Trash Monster. 1982. California State Department of Education, Publication Sales, P.O. Box 271, Sacramento, CA 95802. (916) 445-1260. Curriculum for older students addressing solid waste concepts, problems, and solutions.

They Call It the Waste Stream. A 20-Minute Video of Recycling. 1988. Solid Waste Management Division, Snohomish County Public Works, 4th Floor, County Administration Building, Everett, WA 98201. (206) 388-3425.

Toxics in My Home? You Bet! 1984. Golden Empire Health Planning Center, 2100 21st St., Sacramento, CA 95802. $6. One-week courses in household hazardous waste for grade levels K-3, 4-6, 7-9, 10-12.

Trees Are Terrific. 1985. NatureScope, National Wildlife Federation, 1412 16th Street, NW, Washington, DC 20036. (202) 797-6800.

Twelve Facts About Waste Paper Recycling. 1988. American Paper Institute, 260 Madison Ave., New York, NY 10016.

Waste. 1985. Bullfrog Films, Oley, PA 19547. (800) 543-3764. Purchase: $150. Rental: $50. Film discussing consumer habits, and reviewing examples of generation, disposal, and reuse of toxics, municipal, sewage, and space waste (29 min). Grades 7-adult.

Waste Away! 1987. Vermont Institute of Natural Science (VINS), P.O. Box 86, Woodstock, VT 05091. (803) 457-2779. Curriculum guide.

Waste Education Program Curriculum. 1988. Minnesota Waste Management Board, 1350 Energy Ave., St. Paul, MN 55108. (612) 649-5786.

Waste: A Hidden Resource. 1989. Keep America Beautiful, Inc. Curriculum, 9 West Broad St., Stamford, CT 06902. (203)323-8987. $50. Curriculum for grades 7-12.

Waste: A Hidden Resource. Kentucky Center for Math, Science, and Environmental Education, Western Kentucky University, Bowling Green, KY 42101. (502) 745-4424. State curriculum guide for grades 7-12.

Waste Information Series for Education. 1989. Michigan Department of Natural Resources, Stevens T. Mason Building, Box 30028, Lansing, MI 48909. (517) 373-0540. Curriculum on waste management and resource recovery topics.

Waste Management Recycling Topics. 1989. Florida Department of Education, Knott Building, Tallahassee, FL 32399. (904) 487-1785. Waste recycling resource guide and curriculum materials.

Waste in Place. 1988. Keep America Beautiful, Inc., Stamford, Connecticut. A sequential curriculum for grades K-6. (203) 323-8987.

Waste Wise: Slide Set. 1987. Cornell Media Services, Audio Visual Resource Center, Building 8, Research Park, Ithaca, NY 14850. (607) 255-2090. $47. Slide show for high school level or older students.

The Wizard of Waste. 1982. California State Department of Education, Publication Sales, P.O. Box 271, Sacramento, CA 95802. (916) 445-1260. A two-week introduction to solid waste concepts for primary level children.

What You Should Know about Recycling. 1989. Channing L. Bete Col, S. Deerfield, MA. Cartoon presentation explaining the recycling process and promoting its use. (800) 628-7731.

Woodsy Resource Gold Mine. 1989. Cornell Media Services, Audio-Visual Resource Center, Building 8, Research Park, Ithaca, NY 14850. (607) 255-2090. $49. Slide show on natural resources for elementary students.

Woodsy Waste Wise. 1988. Cornell Media Services, Audio Visual Resource Center, Building 8, Research Park, Ithaca, NY 14850. (607) 255-2090. $39. Slide show for elementary students.

EVALUATION

The U.S. Environmental Protection Agency is interested in feedback from you regarding your use of "Let's Reduce and Recycle: Curriculum for Solid Waste Awareness" in your classroom. We would appreciate your taking a few minutes to respond to the evaluation form on the following pages.

Please return your evaluations to:

OSW Publications
Office of Solid Waste
Attn: Curriculum
U.S. Environmental Protection Agency
401 M Street SW
Washington, DC 20460

We look forward to hearing from you.

CURRICULUM EVALUATION

Please indicate your response to the curriculum in the following areas:

	Strongly Disagree	Disagree	Agree	Strongly Agree
Ease of Presentation				
The activities followed a logical, easy-to-follow sequence.				
The lessons provided sufficient background information.				
Activities were easy to implement with the facilities at your school.				
Activities were easy to implement in desired time frames.				
Student Interest				
Students enjoyed the activities and found them informative.				
Students were motivated to pursue particular subjects in more depth.				
Students were challenged by the format of activities.				
Students retained knowledge gained from one activity to another.				

	Strongly Disagree	Disagree	Agree	Strongly Agree
Appropriateness				
Concepts and vocabulary were appropriate to your class's learning level.				
Topics were covered in sufficient depth.				
Activities were easily adapted to different grade levels.				
Activities were easily incorporated into related subject areas.				
Effectiveness				
Objectives clearly outlined goals and guided instruction.				
Organization of the sections of the guide allowed maximum utility.				
Page layout facilitated use of the guide.				
Use of graphics was instructive and visually appealing.				

Additional Materials

Please indicate the level of usefulness of the following materials:

	Not Useful	Somewhat Useful	Very Useful
Clip Art			
Community Profile			
Glossary			
Handouts and Worksheets			
Skit			
List of State Solid Waste Agencies			
List of Resources			

What would make any of the above materials more useful to you?

Are there any additional materials that would have aided instruction?

What were the curriculum's greatest strengths?

What areas could be improved? Do you have any suggestions for improvement?

Please comment in more detail on any other aspect of the guide. (Use additional sheets if necessary.)

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